TECHNICAL MANUAL

SYNTHESIZER TUNER

T-X6 (L).R-S55.R-77

JVC

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1. INTRODUCTION TO TUNER

At present, many manufacturers are introducing tuners, which includes digital tuners. This manual is to better understand the operating principle of tuners and obtain further knowledge on the operating principle of the digital synthesizer tuner.

1-1 Operations Required in Tuner

This is necessary if it is to:

(1) select the required frequency while rejecting other frequencies.
(2) detect a wide-band FM signal while rejecting interference.
(3) demodulate the output signal to produce accurate left and right channel signals.
(4) amplify these signals to the level required by the preamplifier stage without introducing distortion or crosstalk.

The role of the tuner

Confronted with signals of all types present in the space around the antenna, the role of the tuner is to:

a) select the required signal (TUNING)
b) decode the information held in the signal (DETECTION)
c) amplify this sufficiently to drive the next stage (AMPLIFICATION)

Conventional LW, MW and FM tuners employ the superheterodyne process.

In this process, the incoming radio wave is mixed with a wave from a separate local oscillator in the receiver. The difference frequency (intermediate frequency abbreviated to IF) is then extracted and amplified for detection. This process allows high sensitivity and is not subject to interference to a large extent and therefore it is widely used.

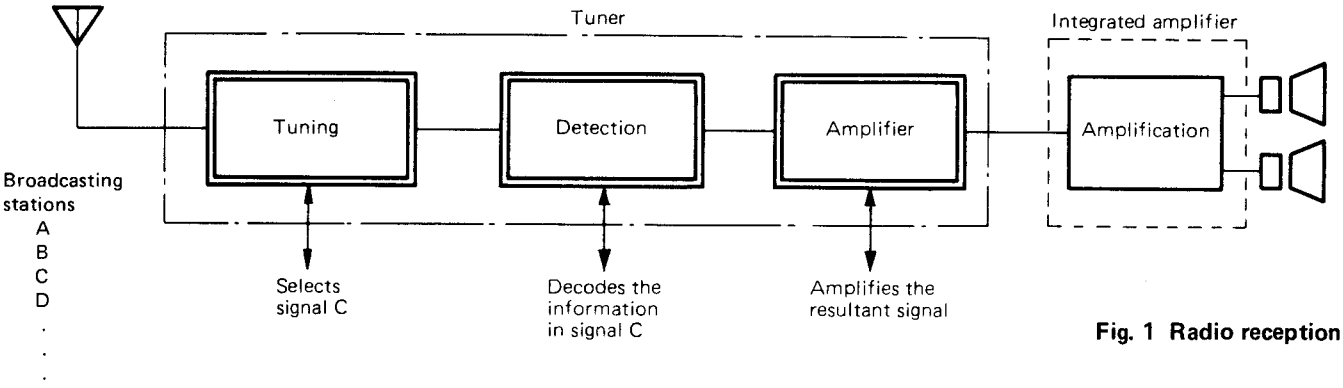


Fig. 1 Radio reception

1-2 Superheterodyne System

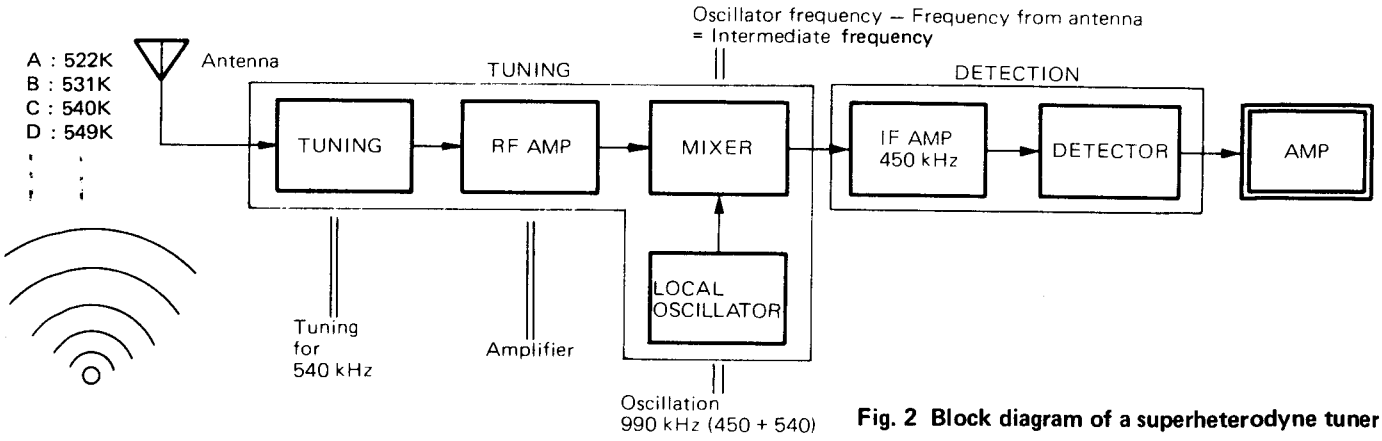


Fig. 2 Block diagram of a superheterodyne tuner

1-3 Introduction to Tuning Systems

(1) Mechanical tuning with variable capacitors

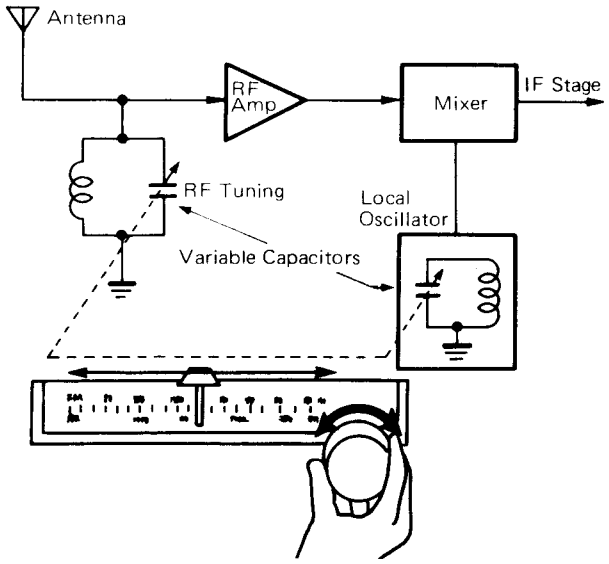


Fig. 3 Mechanical tuning system

Two variable capacitors are necessary, one in the antenna tuning circuit and one in the local oscillator. Conventionally these two variable capacitors are mounted on a single shaft connected to the tuning knob; when the tuning knob is turned, both are tuned to produce the frequency required to receive the desired broadcast.

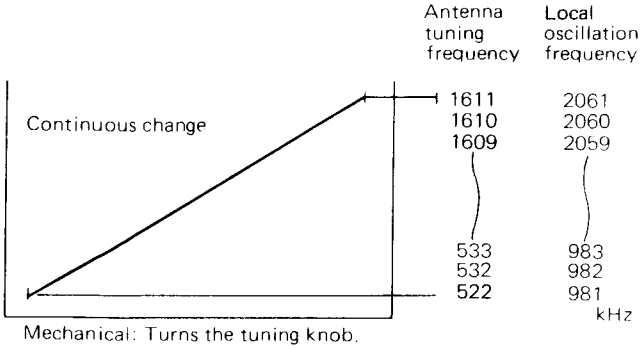


Fig. 4 Frequency change in mechanical tuning system

The term "tuning", when used for radio tuners, actually means "producing accurate local oscillation frequencies" corresponding to the number of possible broadcasting stations.

Tuning accuracy depends upon the accuracy and stability of local oscillation frequencies because off-air signals have quartz-controlled frequencies. For example, supposing the frequency of the signal from a broadcasting station is 540,000 Hz and the IF frequency is 450,000 Hz, the frequency of the local oscillator for tuning to this broadcast must be exactly 990,000 Hz (990,000 – 540,000 = 450,000). But it is extremely difficult to guarantee the frequency of the local oscillator. If it was only 0.25 % different from the required frequency it would be 987,350 Hz, that is, it would result in a deviation of 2,650 Hz. The biggest advantage of the synthesizer tuner is that it resolves this problem.

(2) Electrical system with tuning diodes

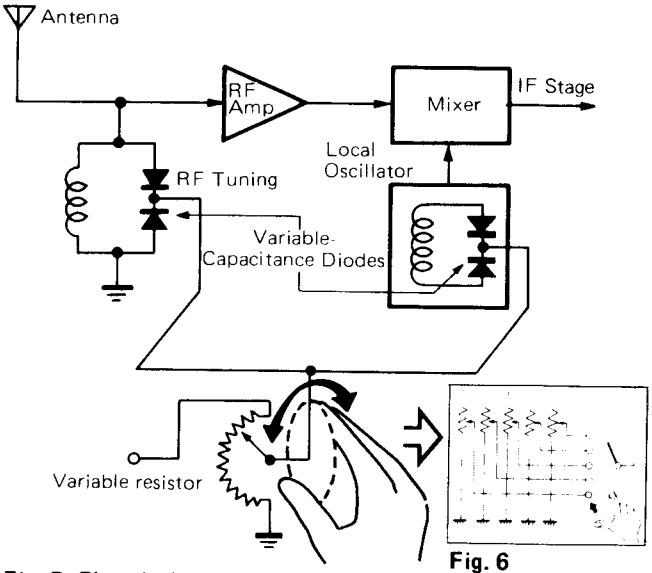


Fig. 5 Electrical tuning system

Fig. 6 Preset system

Semiconductor elements are used in place of the variable capacitors. Tuning is done by varying the DC voltage applied to these elements so that they produce the required frequencies.

In the tuning system (1) when the tuning knob is turned, the capacitance of the variable capacitors is varied continuously, while when the tuning knob is turned in the tuning system (2), the voltage applied to the semiconductor elements is varied continuously; that is, by varying the resistance of a variable resistor in both systems the frequency can be varied continuously as shown in **Fig. 7.** One variation of system (2) is that the voltage can be selected in steps by using preset resistors. **(Fig. 6)**

These methods do not discriminate between frequencies which are used for broadcasting and those which are not. They also are unable to lock to the required frequency.

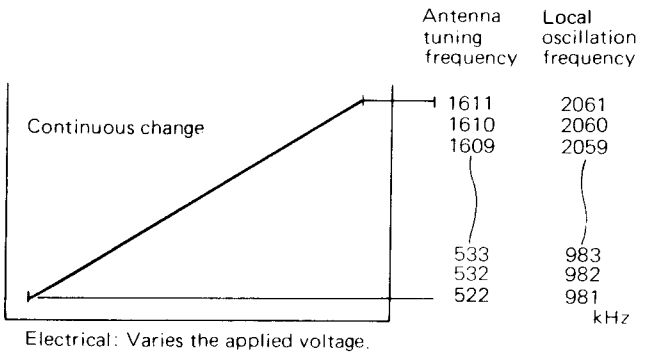


Fig. 7 Frequency change in analog tuning systems

(3) Synthesizer tuning system

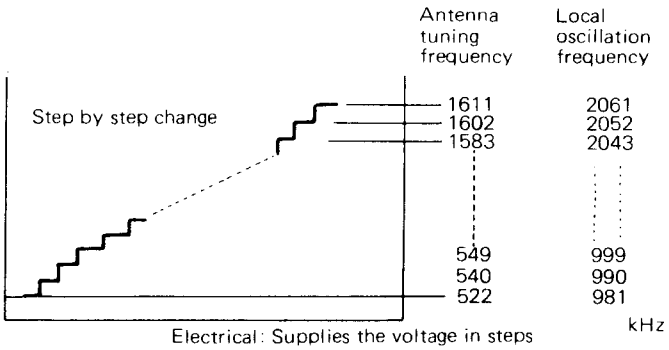


Fig. 8 Frequency change in digital tuning systems

In the synthesizer tuning system the tuning frequency is varied in steps as shown in **Fig. 8.**
The chief advantages of the synthesizer tuning system are:
(1) once tuned, the frequency never changes,
(2) the tuner only tunes to frequencies which are used for broadcasting, not inter-station frequencies.

Because of this, the tuner can be accidentally detuned as a result of a mechanical shock or a change in the ambient temperature.

1-4 Synthesizer systems

Voltage Synthesizer vs. Frequency Synthesizer
Both types of synthesizer tuner offer the advantages that they only tune to frequencies used for broadcasting and that, once tuned, there is no frequency drift due to changes in internal or external conditions.

- **Voltage Synthesizer**

The LSI used in a Voltage Synthesizer Tuner has a memory which holds 1024 preset voltage values provided by the 10 voltage networks. When the user presses the UP or DOWN automatic tuning control, he is selecting a voltage to be fed to the local oscillator as the "tuning voltage". If there is a strong, receivable station broadcasting at a certain frequency, the servo lock circuit and the detector in the tuner work together to lock the local oscillator to that particular frequency.
Voltage synthesizer tuners use a quartz crystal oscillator to generate a reference frequency which is used to control the digital frequency display.

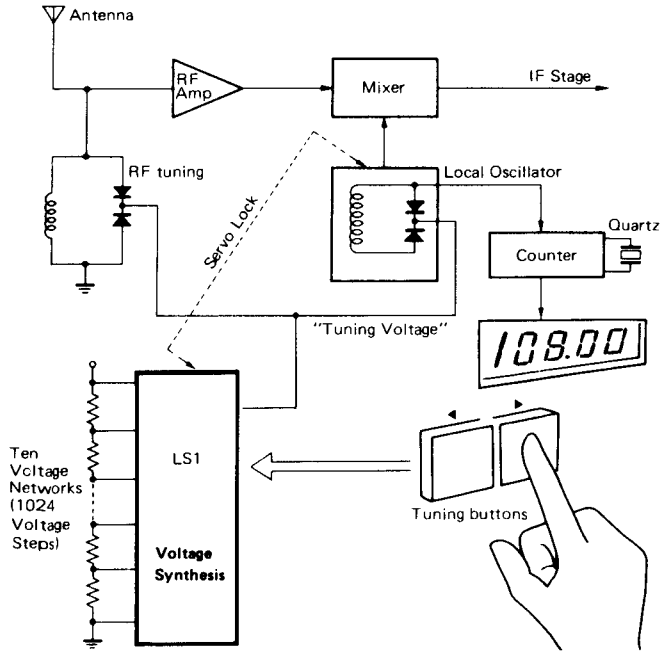


Fig. 9 Voltage synthesizer tuning system

- **Frequency Synthesizer**

This uses an extremely accurate quartz crystal oscillator together with a PLL (Phase Locked Loop) circuit to electronically synthesize any number of frequencies. Because this synthesis is done from the precise frequency of the quartz crystal oscillator, these frequencies are accurate and stable. The PLL contains a programmable frequency divider, a phase comparator and other devices which work together to accomplish the required frequency synthesis. The user activates the synthesis with the UP or DOWN automatic tuning button or manual frequencies synthesized from the reference frequency. Both the synthesizer and digital display use the frequency of a single quartz crystal oscillator as reference; because of this, this system offers the ultimate in tuning accuracy.

Principle of frequency synthesis
The synthesizer used in the tuner is a "Frequency Synthesizer", used, as its name implies, for frequency synthesis. That is, it is used to produce a number of stable frequencies from a single reference frequency.

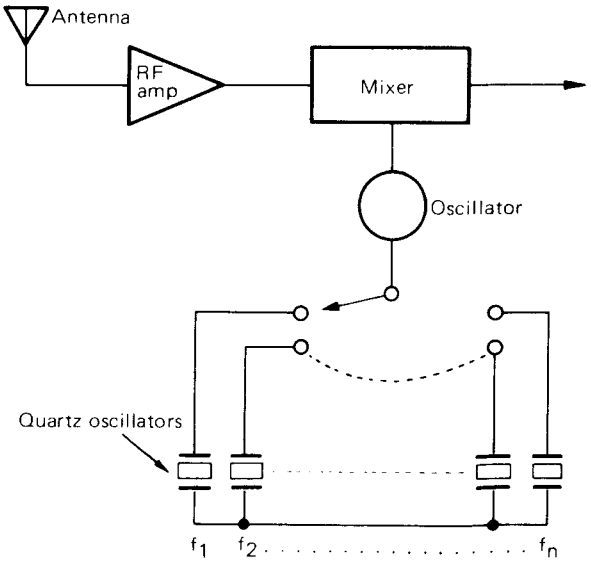
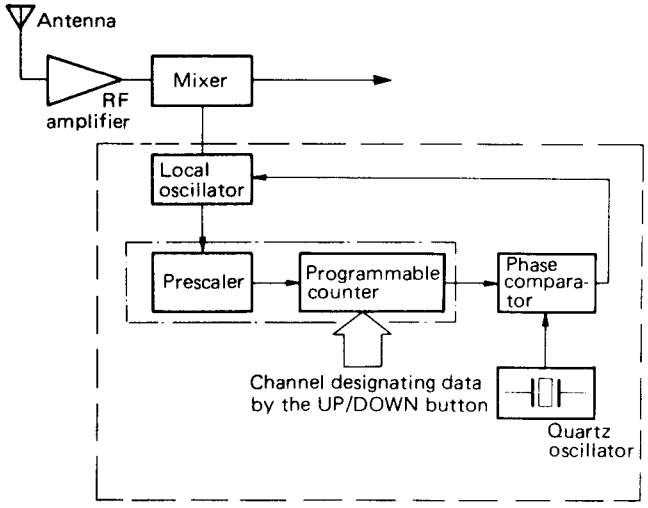


Fig. 10 Frequency synthesizer (1)



Note: The programmable counter is a counter which can be set externally.

Fig. 11 Frequency synthesizer (2)

There are two methods for doing this.

(1) Using a large number of quartz oscillators, required frequencies are produced by changing their combination. (**Fig. 10** on page 3.)

(2) Using a single quartz oscillator, required frequencies are produced by digital logic technology. **(Fig. 11)**

The quartz oscillator is more expensive than conventional oscillators so it is impossible to use as many quartz oscillators as there are broadcasting stations. (122 stations are possible between 522 and 1611 kHz, so it would be necessary to use 122 oscillators.) However, if all required frequencies could be synthesized from the frequency of a single quartz oscillator, it would be possible to produce a tuner which was not too expensive or bulky.

To achieve this, the Quartz Frequency Synthesizer Tuning System was developed. In this system, digital technology is employed to generate the necessary (fn = 122 in this example) frequencies from a single quartz oscillator by electronic synthesis.

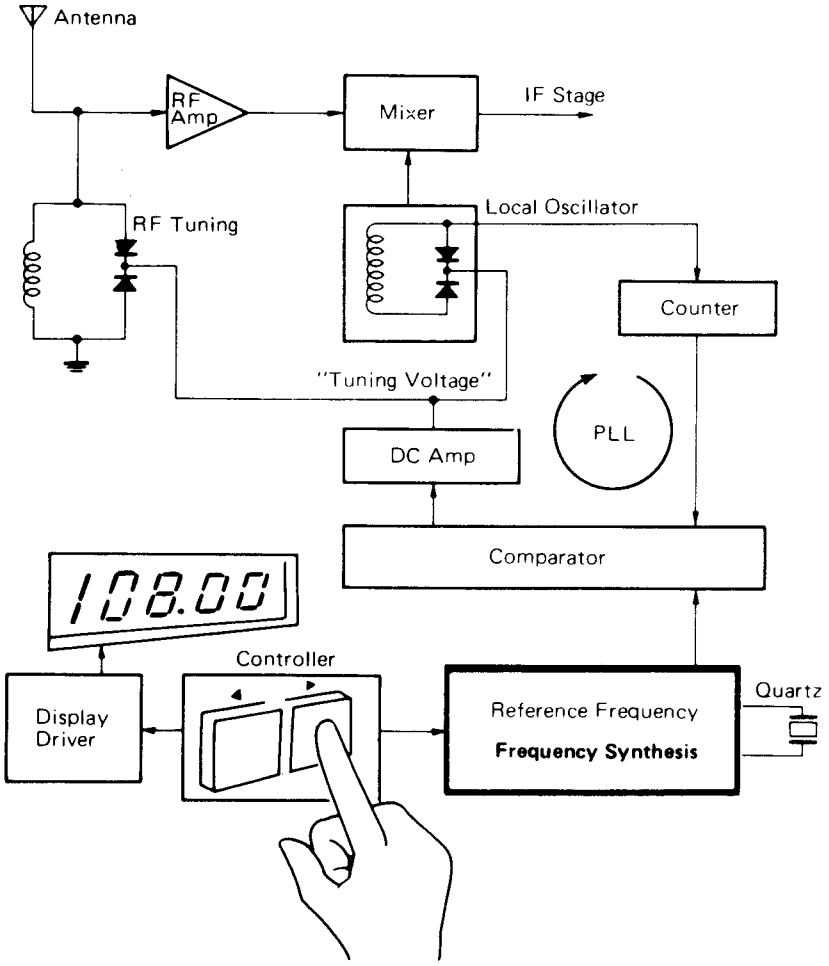


Fig. 12 Frequency synthesizer tuning system

2. PRACTICAL CIRCUITS AND THEIR FUNCTIONS

2-1 R-S55 Receiver (voltage type)

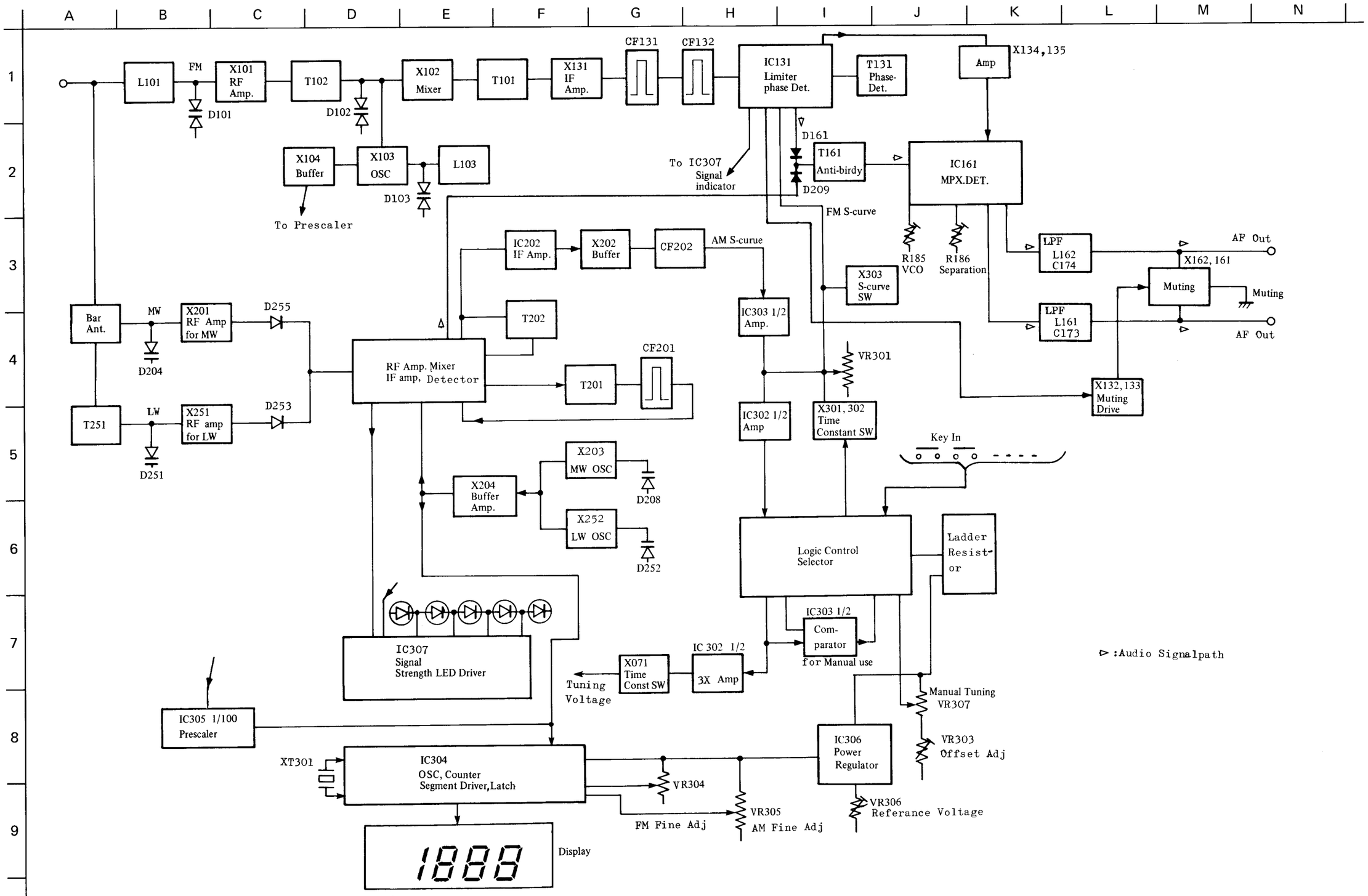


Fig. 13 Block Diagram for R-S55 Tuner Section

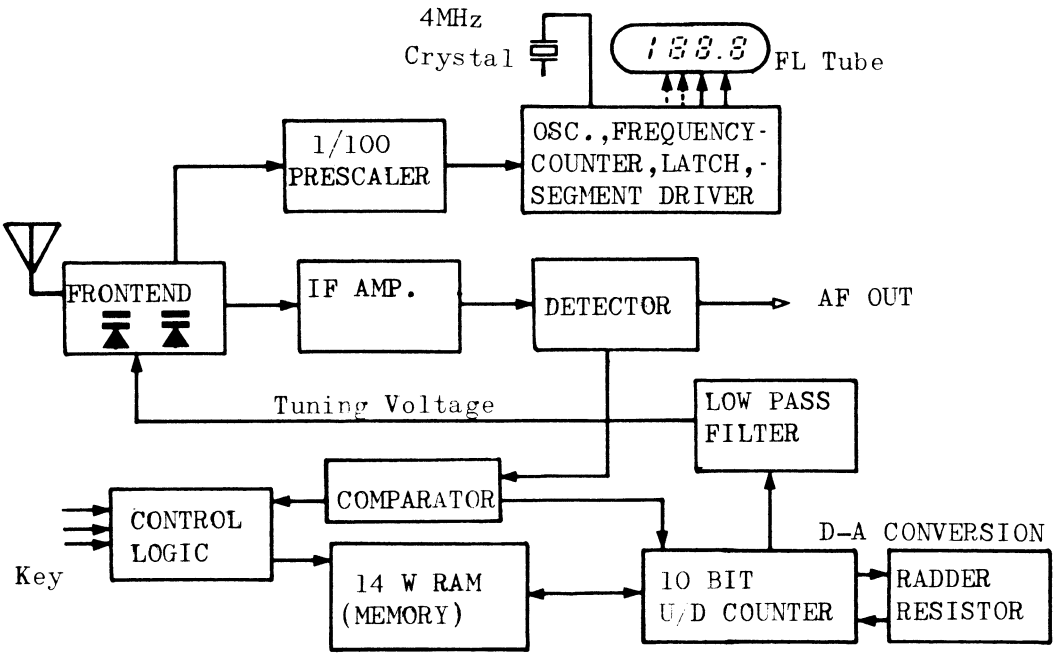


Fig. 14 Voltage synthesizer tuner

2-1-1 FM Tuner Circuit

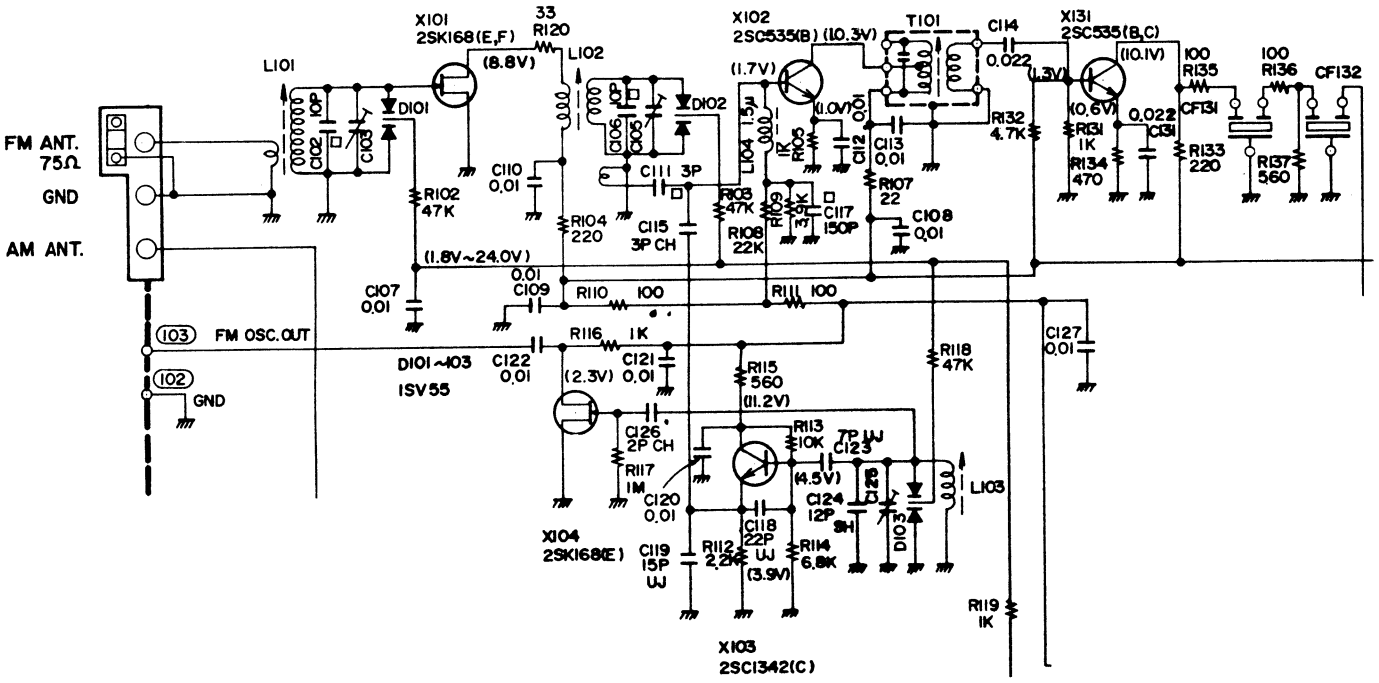


Fig. 15 FM Front-end IF Amplifier Circuit

X101: FM-RF amplifier
X102: Mixer: mixes the desired signal with the local oscillation signal.
X103: Local oscillator
X104: Buffer amplifier
X131: IF amplifier

The tuning voltage varies in the range of +1.8 V to +24 V. In addition, the desired input signal is converted into the IF frequency of 10.7 MHz.

2-1-2 FM-IF Amplifier and MPX Circuit

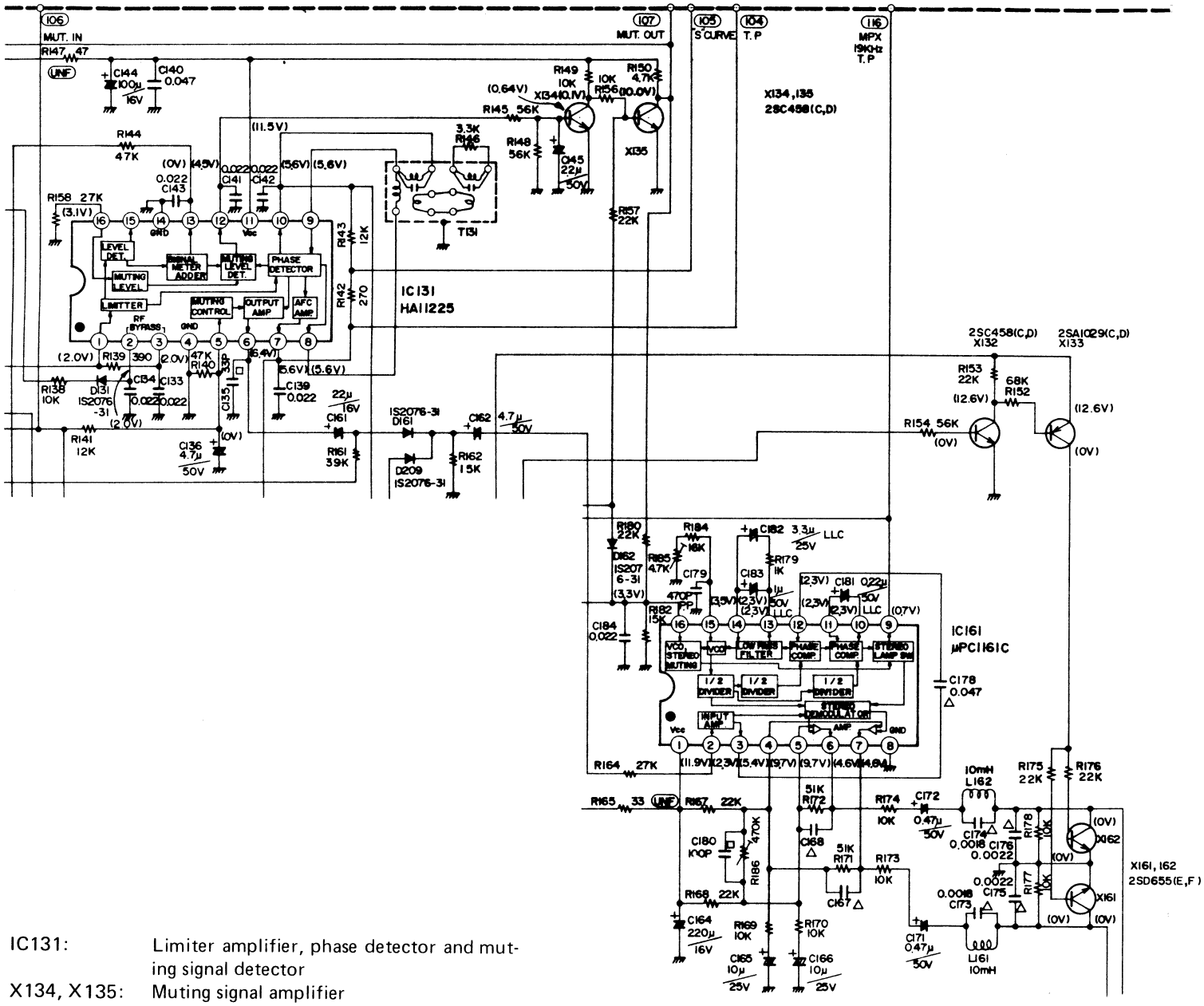


Fig. 16 FM Detector/MPX Circuit

IC131:	Limiter amplifier, phase detector and muting signal detector
X134, X135:	Muting signal amplifier
X132, X133:	Audio muting control amplifiers by logic MUT
X161, X162:	Muting switch for audio signal
IC162:	MPX demodulator
R185:	Multiplex VCO adjustment, set-in 19 kHz
R186:	FM stereo separation adjustment

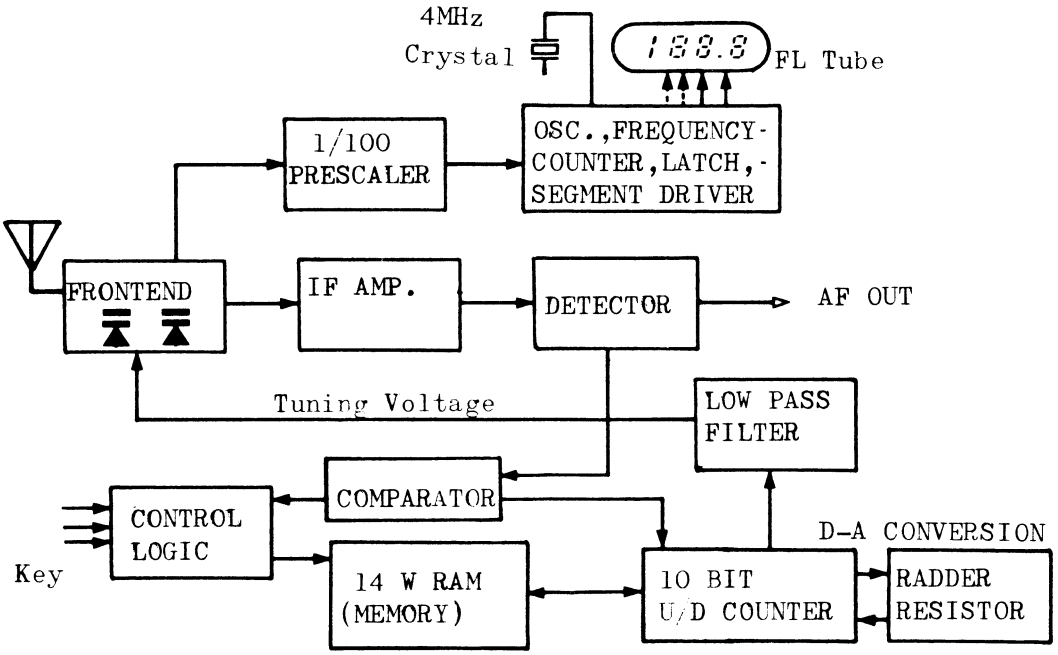
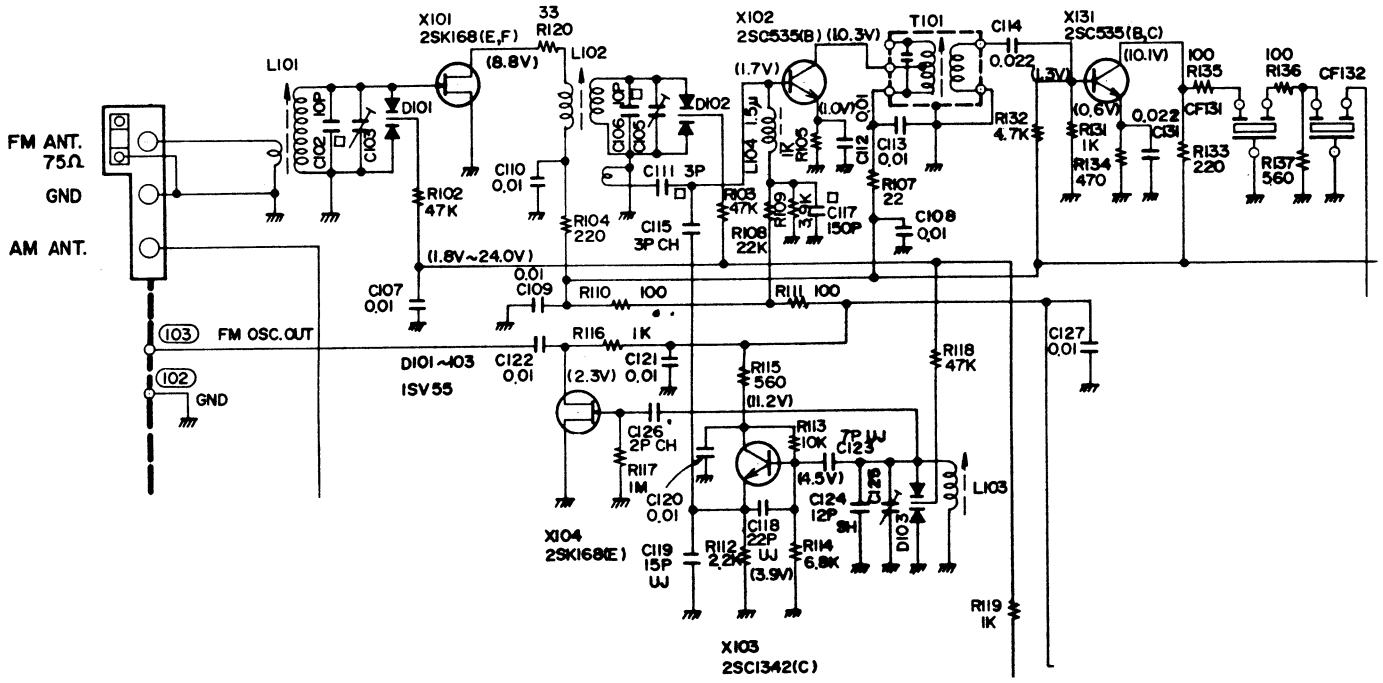


Fig. 14 Voltage synthesizer tuner

2-1-1 FM Tuner Circuit



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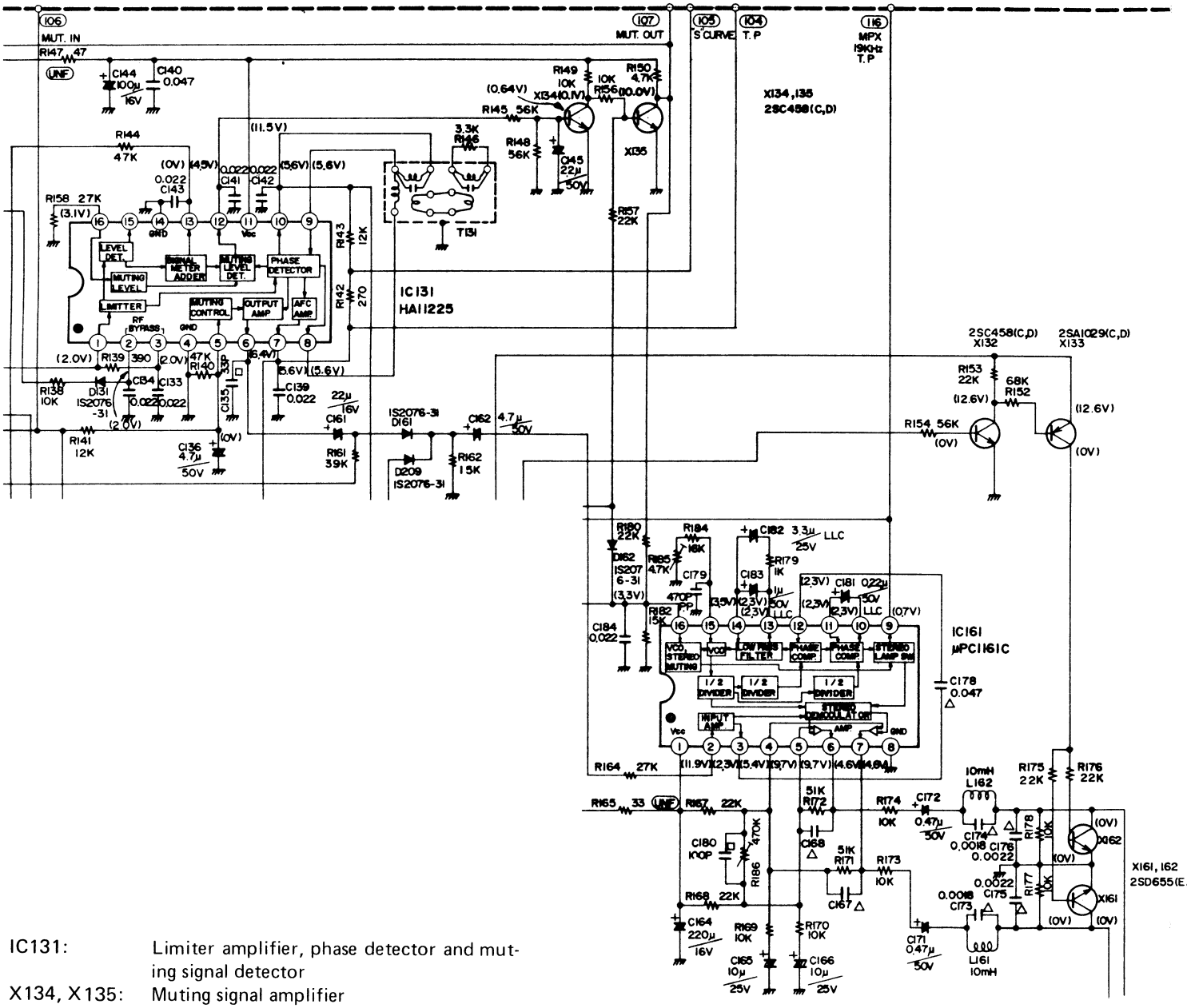
2-1-2 FM-IF Amplifier and MPX Circuit



IC131:	Limiter amplifier, phase detector and muting signal detector
X134, X135:	Muting signal amplifier
X132, X133:	Audio muting control amplifiers by logic MUT
X161, X162:	Muting switch for audio signal
IC162:	MPX demodulator
R185:	Multiplex VCO adjustment, set-in 19 kHz
R186:	FM stereo separation adjustment

Fig. 16 FM Detector/MPX Circuit

2-1-3 AM Tuner, RF Amplifier, and Mixer

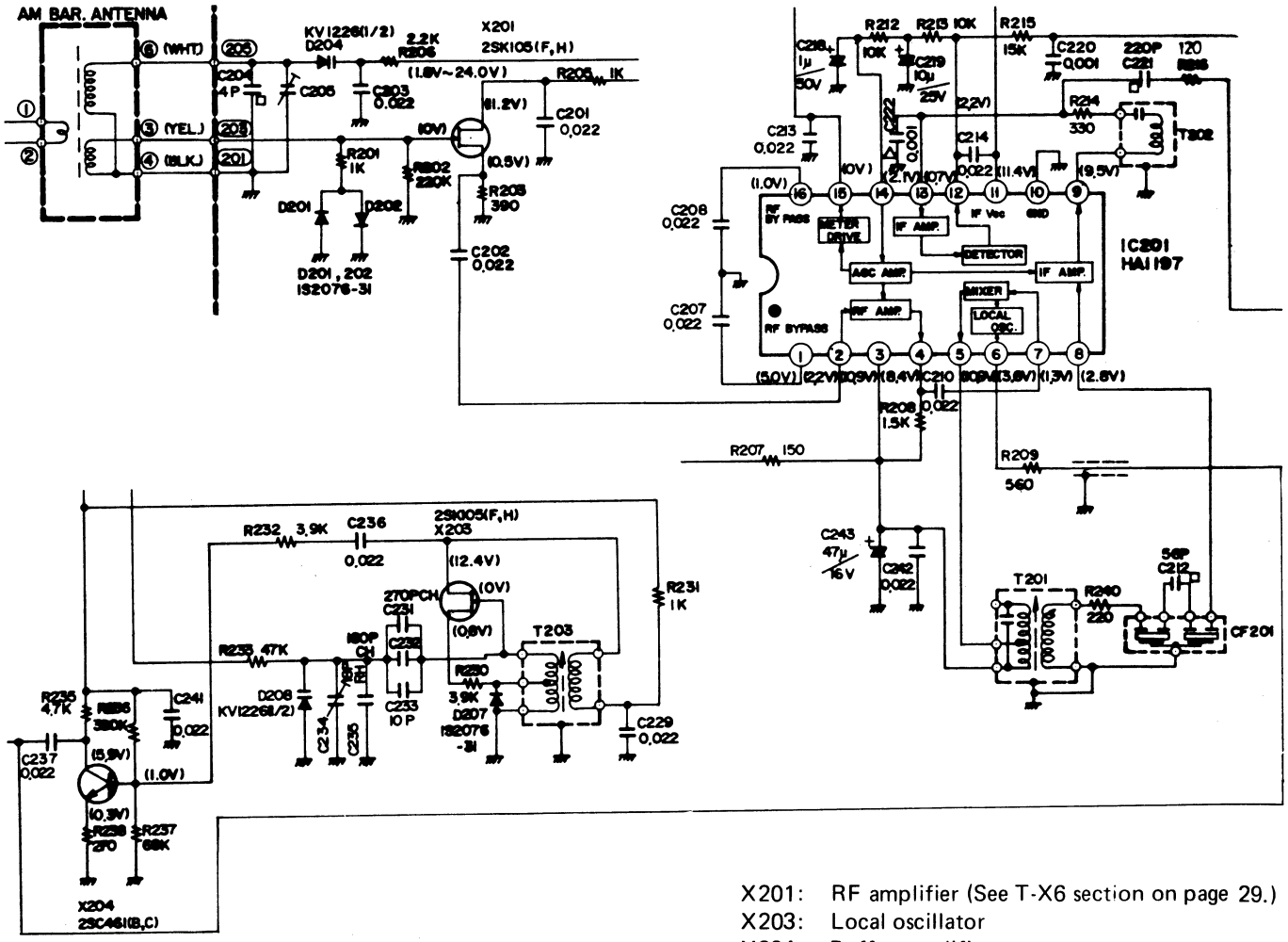


Fig. 17 AM Tuner Circuit

X201: RF amplifier (See T-X6 section on page 29.)
X203: Local oscillator
X204: Buffer amplifier
IC201: Mixer, IF amplifier and detector

2-1-4 AM S-curve

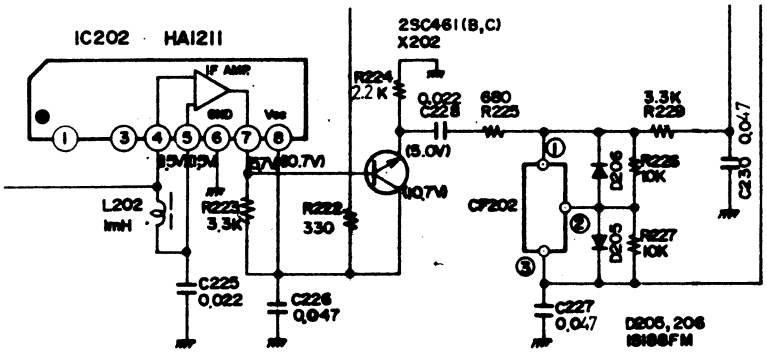


Fig. 18 AM S-curve Detector Circuit

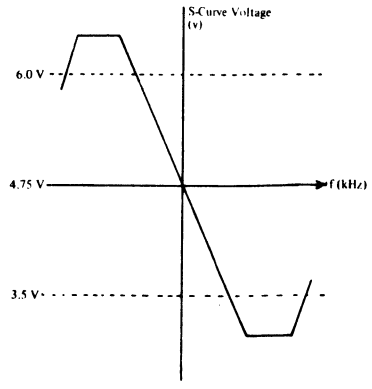


Fig. 19 AM S-curve Detection Signal

IC202: IF amplifier
X202: Buffer amplifier
CF202: Discriminator: frequency-discriminates and detects the AM-IF signal and produces an S-curve. **(Fig. 19)**

2-1-5 S-curve Amplifier

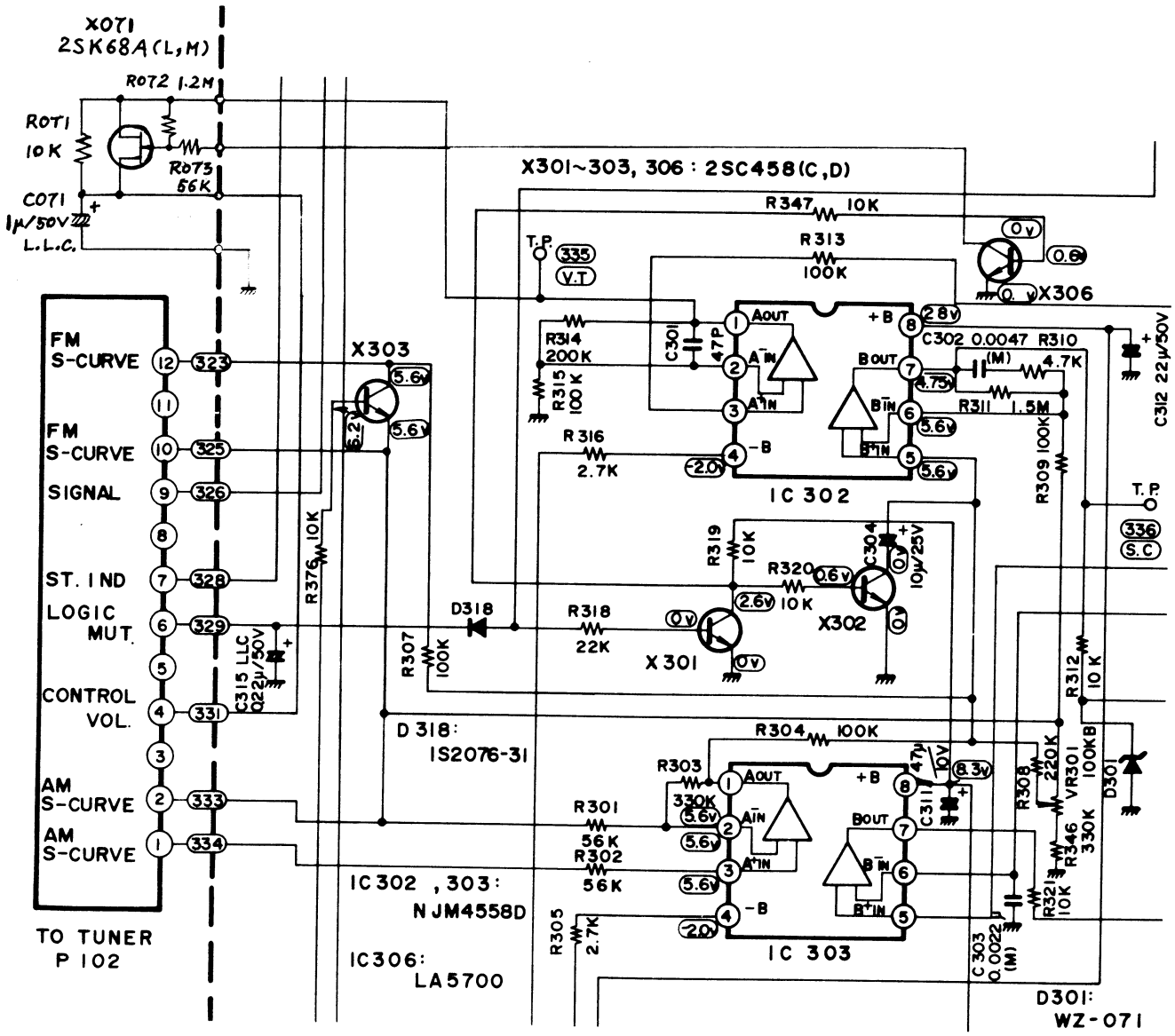


Fig. 20 S-curve/Tuning Voltage Amplifier Circuit

X071: Tuning voltage time constant selection switch: ON when scanned; otherwise OFF

IC302: (Pins 1 – 3) Tuning control voltage 3X amplifier: amplifies the output (0.6 – 8 V) of IC301 3 times (1.8 – 24 V).

IC302: (Pins 5 – 7) S-curve amplifier: shifts the S-curve center value to 4.75 V by VR301.

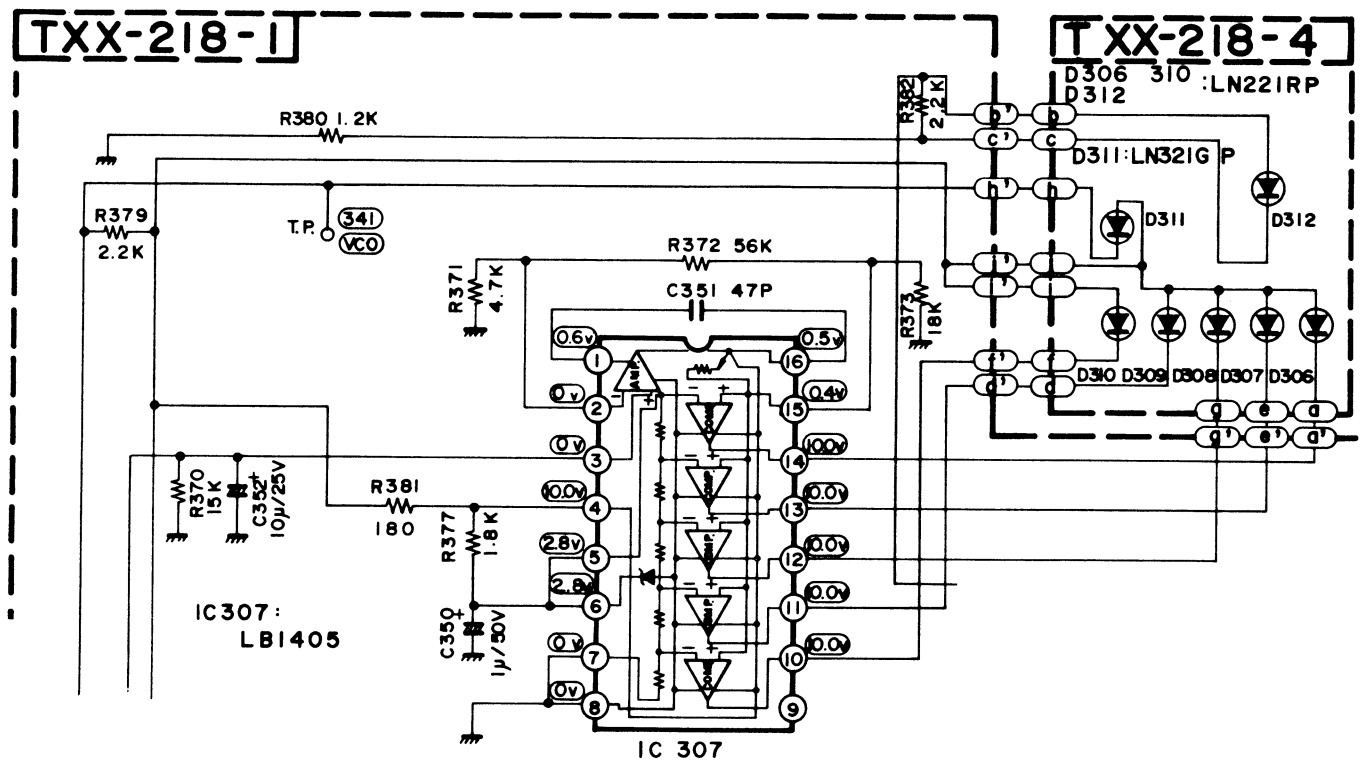
IC303: (Pins 1 – 3) S-curve amplifier for AM: Since the AM discriminator output is smaller, as compared with the FM discriminator output, amplification is required.

IC303: (Pins 5 – 7) Comparator: Since the tuning voltage in the manual mode changes the ladder output voltage, "H" or "L" input is applied to pin 18.

X301, X302: Time constant selection circuit

X303: In AM reception, the AM S-curve output is free from any effect of short-circuiting the FM S-curve output. This is required because the S-curve balance is disrupted when no input is supplied to IC131.

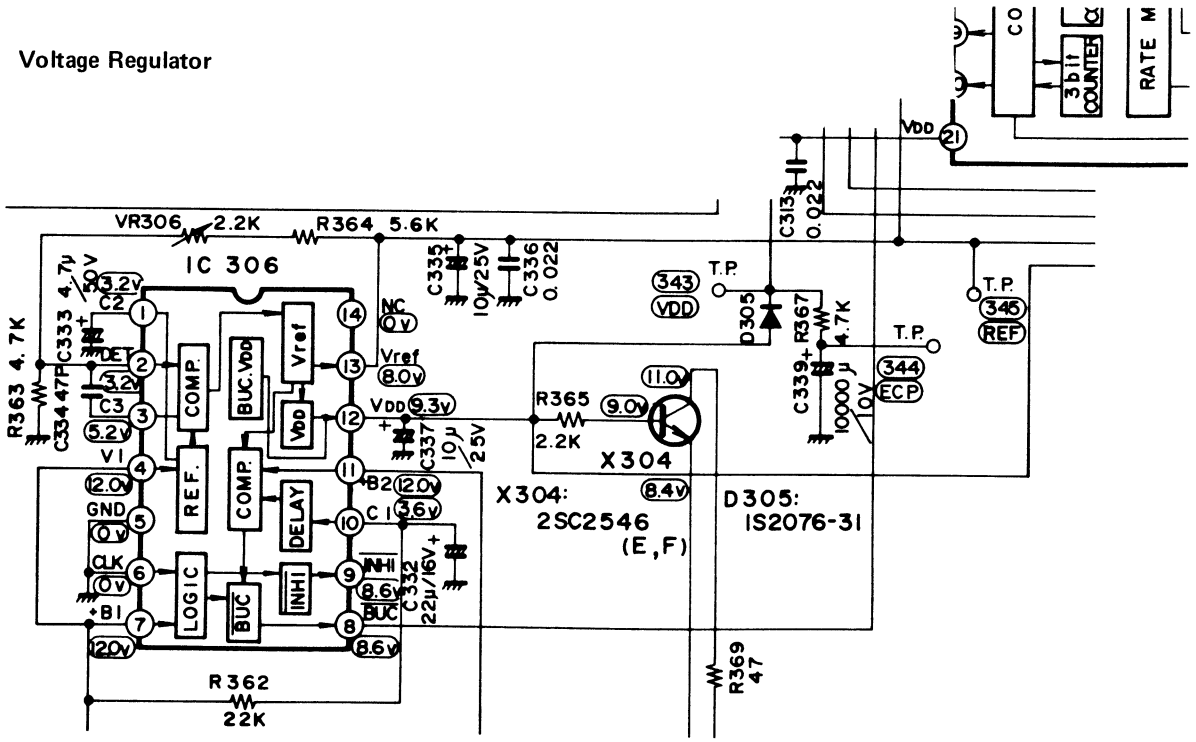
2-1-6 Signal Strength Indicator



IC307 has the five comparison amplifiers for detecting the signal strength; its output drives the LED's.

Fig. 21 LED Indicator Drive Circuit

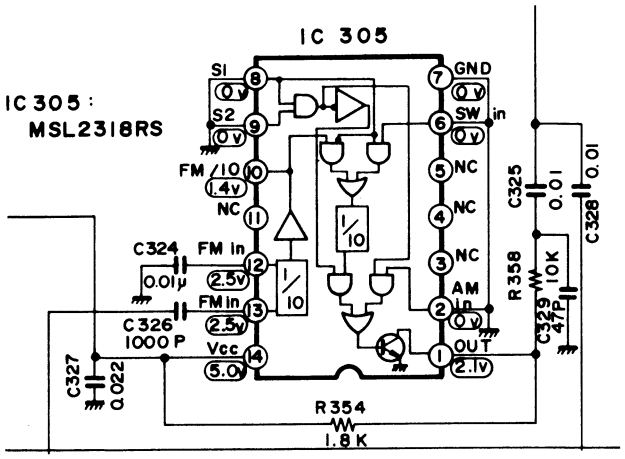
2-1-7 Voltage Regulator



IC306 is the voltage stabilizer IC. One (pin 11) of the two power input terminals remains ON independent of the power switch. The output of pin 8 is the backup control signal for IC301.

Fig. 22 Voltage Stabilizer Circuit

2-1-8 Prescaler



The prescaler divides the FM oscillation frequency by 100.

Fig. 23 Prescaler

2-1-9 Controller IC301

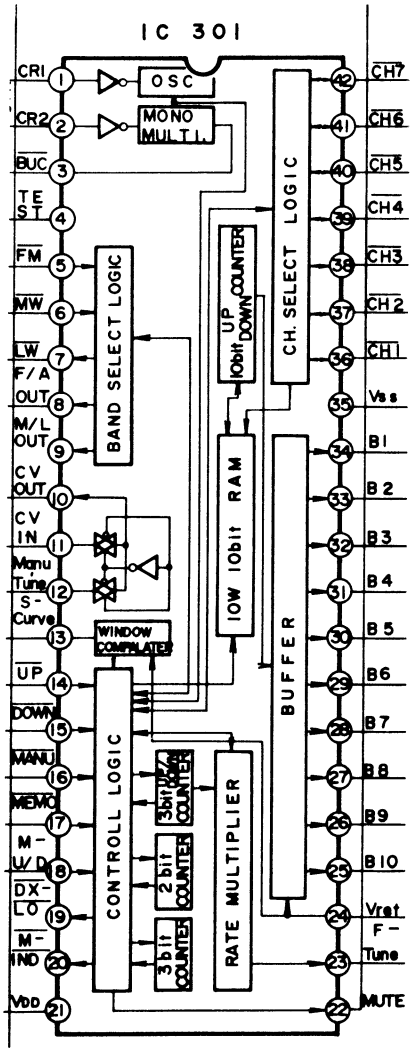


Fig. 24 Controller IC

The functions of the terminals of the voltage synthesizer (LC7207) are briefly described in the following.

Pin No.	Symbol	
1	CR1:	Connects the CR time constant circuit to the outside to form an oscillation circuit to generate the basic clock pulse (R = 0.35 μsec) for LSI system.
2	CR2:	CR time constant terminal for timer circuit.
3	$\overline{BUC}$:	Backup control terminal: enters into the backup mode when at "L" level. All functions apart from "memory protect" are cancelled.
4	TEST:	Test terminal for internal circuitry of LSI: enters into the test mode when at "H" level input.
5	$\overline{FM}$:	FM band specifying input terminal: enters into the FM reception mode when at "L" level input. Subsequently, even when this terminal is at "H" level, it keeps the reception mode. (The "L" level holding time is about 5 msec min.)
6	$\overline{MW}$:	AM band specifying input terminal: enters into the AM reception mode when at "L" level input. Subsequently, even when this terminal is at "H" level, it keeps the reception mode. (The "L" level holding time is about 5 msec min.)
7	$\overline{LW}$:	LW band specifying input terminal: enters into LW reception mode when at "L" level input. Subsequently, even when this terminal is at "H" level, it keeps the reception mode.
8	F/A OUT:	Emits the control signal which indicates what band is received. FM band: "H" level input AM band: "L" level input
9	M/L OUT: in the R-S55 not employed	Emits the control signal which indicates what band is received. MW band: "H" level input LW band: "L" level input
10	CV OUT:	Analog switch output terminal: emits the vari-cap applied signal voltage with the gate output.

11 CV IN: Analog switch input terminal: The LN301 ladder output voltage enters with the gate input.

12 Manu, Tune: Analog signal input terminal: The tuning voltage from the VR307 manual VR enters.

13 S-Curve: FM/AM S-curve voltage (representing the degree of change in detector DC level when tuning to and away from the station) input terminal: Its output acts as the AFC (Automatic Frequency Control) operation control signal with the LSI self-contained window comparator input.

14 $\overline{\text{UP}}$: Auto-search tuning specifying input terminal: Starts UP-search when at "L" level. When the S-curve voltage is applied to pin 13, it stops after the AFC operation. When "L" level is held during UP-search, even when an input is applied to pin 13, UP-search continues.

15 $\overline{\text{DOWN}}$: Auto-search tuning specifying input terminal: Starts DOWN-search when at "L" level. When the S-Curve voltage is applied to pin 13, it stops after the AFC operation. When "L" level is held during DOWN-search, even when a voltage is applied to pin 13, DOWN-search continues.

16 $\overline{\text{MANU}}$: Manual tuning specifying input terminal: enters into the manual tuning mode when at "L" level. At this time, tuning by the VR307 manual VR is possible. When any of terminals UP, DOWN, CH1 – CH6 is at "L" level, the manual tuning mode is cleared.

17 MEMO: Preset memory specifying input terminal: enters into the memory enable state when at "L" level.

18 M-U/D: Applies the output signal of the external comparator which forms the AD converter in the manual mode.
At "H" level, the 10-bit data increases to produce enlarged ladder output voltage.
At "L" level, the 10-bit data decreases to produce reduced ladder output voltage.

19 $\overline{\text{DX-LO}}$: The output terminal which controls the reception sensitivity during auto-search. It is at "L" level during search, but normally at "H" level.

20 $\overline{\text{M-IND}}$: The terminal for the output signal which indicates the manual tuning mode. It is at "L" level in the manual tuning mode.

21 VDD: Power source of LSI:
When in operation: +9 V
When in backup: +5 V

22 MUTE: During auto-search tuning and preset tuning modes, and when switching from one band to other, the "H" level output signal appearing at this terminal is used for the muting control signal.

23 F-Tune: Output terminal for fine tuning: The 8-step PWM (Pulse Width Modulation) output signal appearing at this terminal is used in fine tuning operations. (At all other times, a 50 % duty signal.) The output signal is passed via an externally connected LPF (Low Pass Filter) to form the compensatory voltage for fine tuning purposes.

24 Vref: Reference power source: +8 V typical for D-A converter, wind comparator and reference comparator.

25 B1–B10: ~ 34: Output terminals for the 10-bit UP/DOWN counter: performs D-A (digital analog) conversion with the LN301 ladder resistance connected to the outside.

35 Vss: Ground terminal for LSI

36 $\overline{\text{CH1}}$ – ~ 42 $\overline{\text{CH7}}$: Channel specifying input terminals and received channel display output terminals: At "L" level, memorized stations are tuned in. When terminal MEMO is at "L" level, when any of terminals $\overline{\text{CH1}}$ – $\overline{\text{CH7}}$ is at "L" level, the station being received is memorized.

2-1-10 Counter/Segment Drive IC304

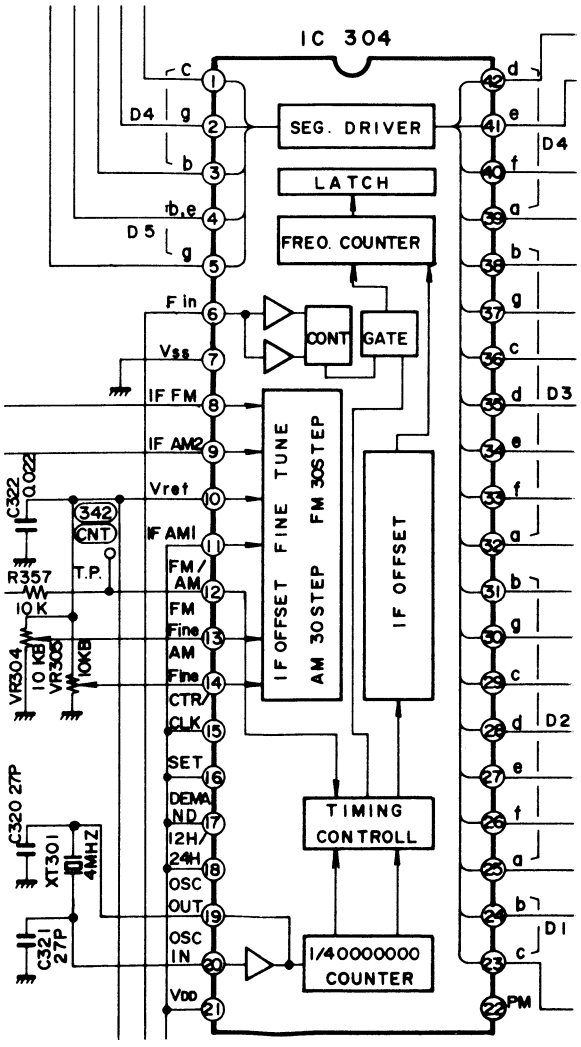


Fig. 25 Counter/Segment Drive IC

Pins 1 – 5 and 23 – 42: Segment output terminals; P channel, open drain system.

FM Fine: Fine adjustment input terminal for correcting the frequency deviation in the FM-IF ceramic filter.

AM Fine: Fine adjustment input terminal for correcting the frequency deviation in the AM-IF ceramic filter.

2-1-11 Auto-tuning Correction Function

1. Fetech Operation
   When a preset station is tuned in while the S-curve position is deviated due to tuner tuning point drift, etc., the voltage is swung ±8 steps (about ±58 mV) with the preset voltage as the reference until the S-curve is arranged properly.
2. AFC (Automatic Frequency Control) Operation along S-curve
   In auto-search or preset tuning, both the FM and MW stations are automatically corrected to the respective optimum reception point by the S-curve signal.
3. Fine Tuning
   The PWM signal from terminal F-Tune is D-A converted and superimposed on the 10-bit D-A conversion voltage (ladder voltage). Thus, the fine tuning property with a resolution of about 12 bits is obtained.

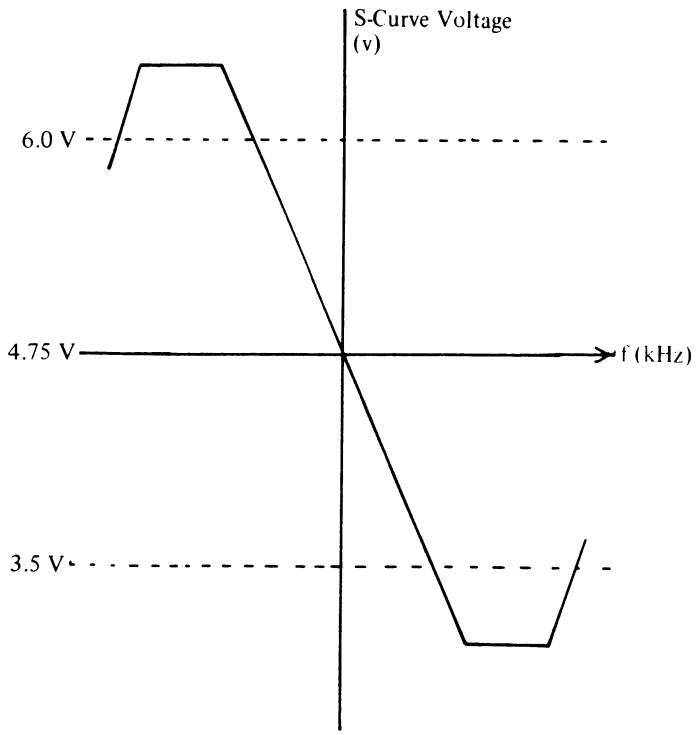


Fig. 26 S-curve Signal

2-1-12 Q & A

Q1: The AM S-curve detection circuit is not used in any other synthesizer tuning system. Why is it required here?

A1: In both AM and FM reception, the LSI's are controlled by using the S-curve signal. The AFC operation is also performed by using the reception frequency deviation in the S-curve signal. **(Fig. 26)**

Q2: When the tuner does not stop automatically while scanning, what is the reason?

A2: First check whether or not the tuner functions properly. During this check, confirm that the desired station can be received manually.
Next, check whether the S-curve signal appears at TP-336. This signal must be entered in pin 13 of IC301.

Q3: How does X071 operate?

A3: X071 is driven by X306. In scanning, X071 goes ON with logic signal MUT and passes the tuner control signal as it is. In normal reception, X071 goes ON and serves as a filter consisting of a 10 kΩ resistor and a 1 μF capacitor, thus improving S/N ratio.

Q4: How does the backup system works when the power is OFF?

A4: The charged voltage at C339 of 10,000 μF acts as the backup power supply. The current flowing into IC301 becomes about 200 μA by entering pin 3 (terminal $\overline{\text{BUC}}$) of IC301 at "L" level. This current is kept at more than 3 V.

2-2 R-S77 Receiver (frequency type)

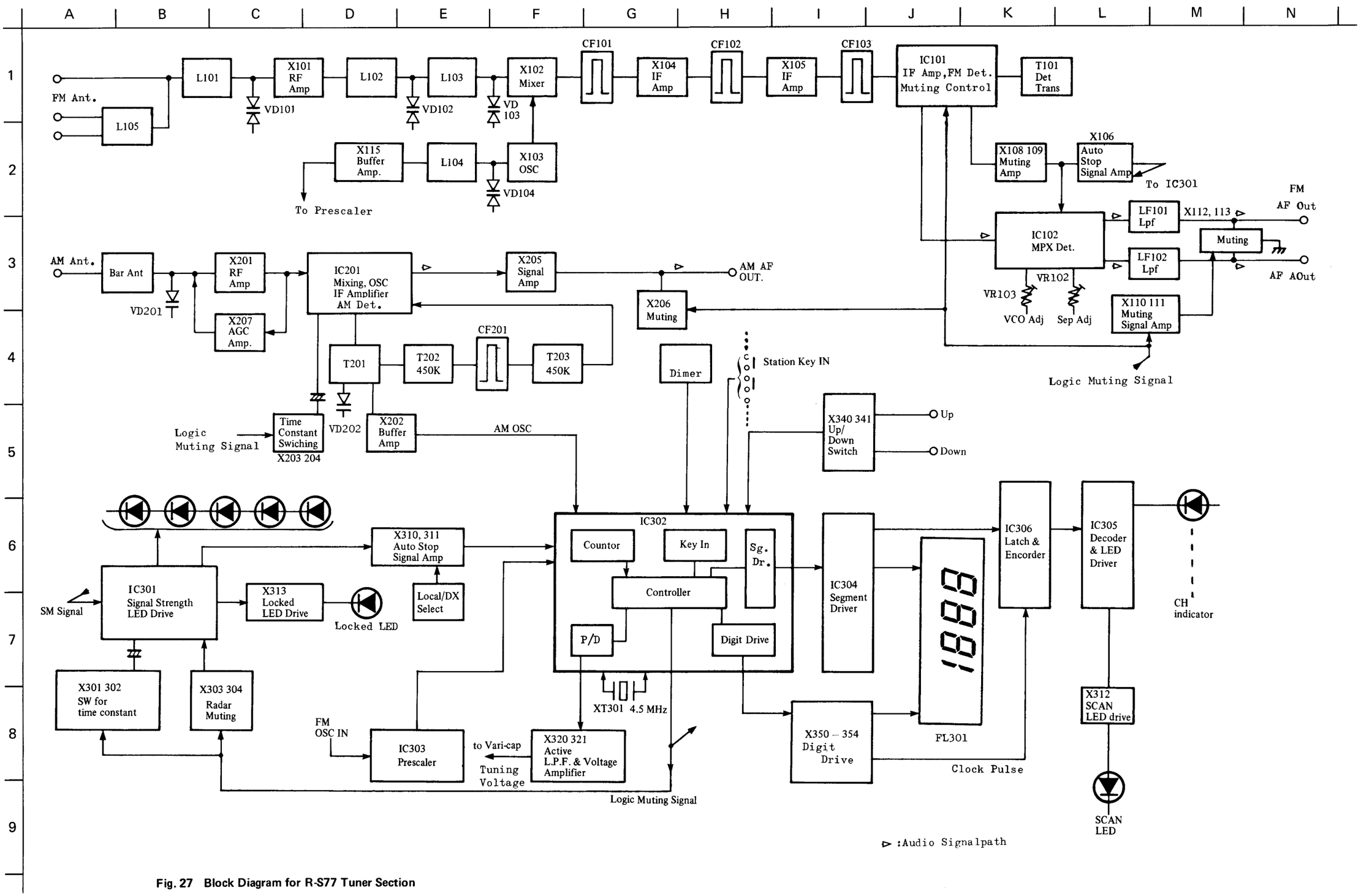


Fig. 27 Block Diagram for R-S77 Tuner Section

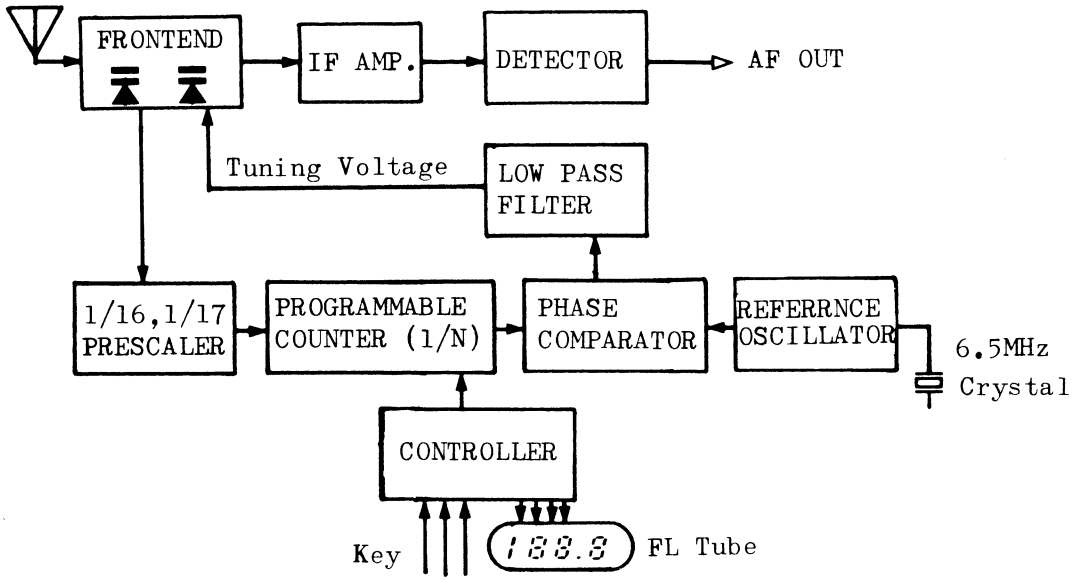


Fig. 28 Frequency Synthesizer Tuner

2-2-1 FM Tuner Circuit

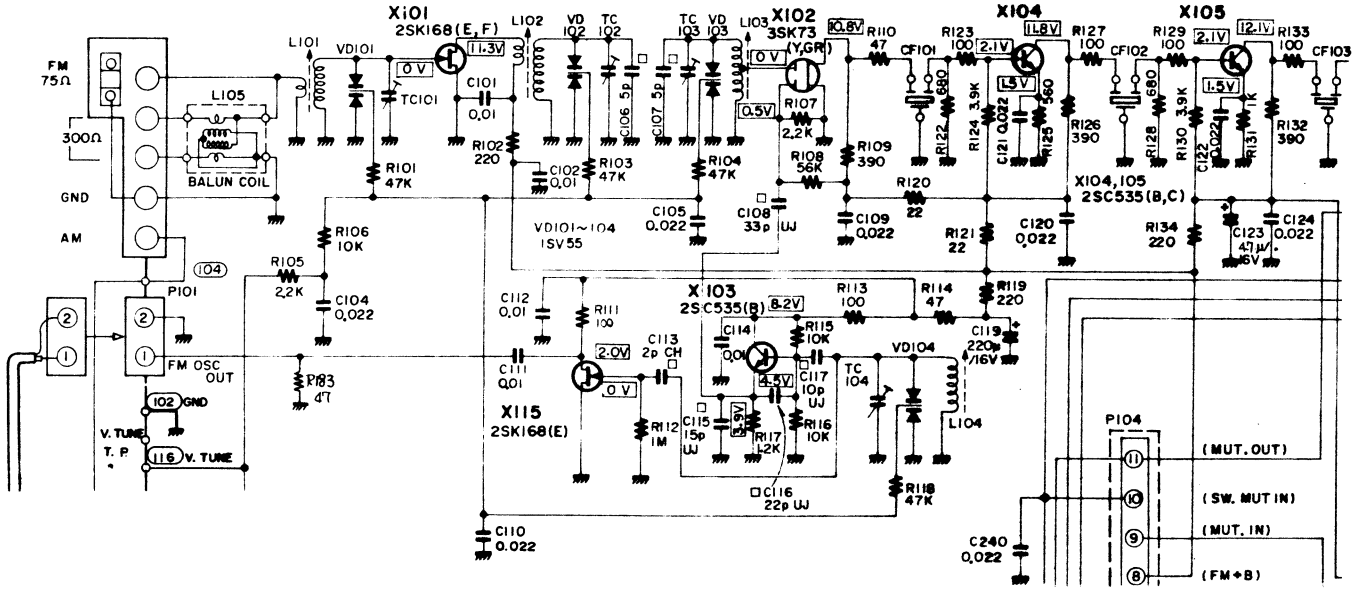


Fig. 29 FM Front-end IF Amplifier Circuit

The tuner circuit is used for selection of desired stations. The Ceramic Filter functions to select between; the amplification of the RF signal up to the input level of IC101, or frequency conversion of the RF signal with the local oscillation frequency.

X101: RF (high frequency) amplifier
X102: Mixer: mixes the input signal with the oscillation signal.
X103: Local oscillator
The local oscillation frequecy is obtained from L104, VD104 and TC104.
X104, X105: IF amplifier & limiter
X115: Buffer amplifier of pickup oscillation signal.

2-2-2 FM and MPX Detectors

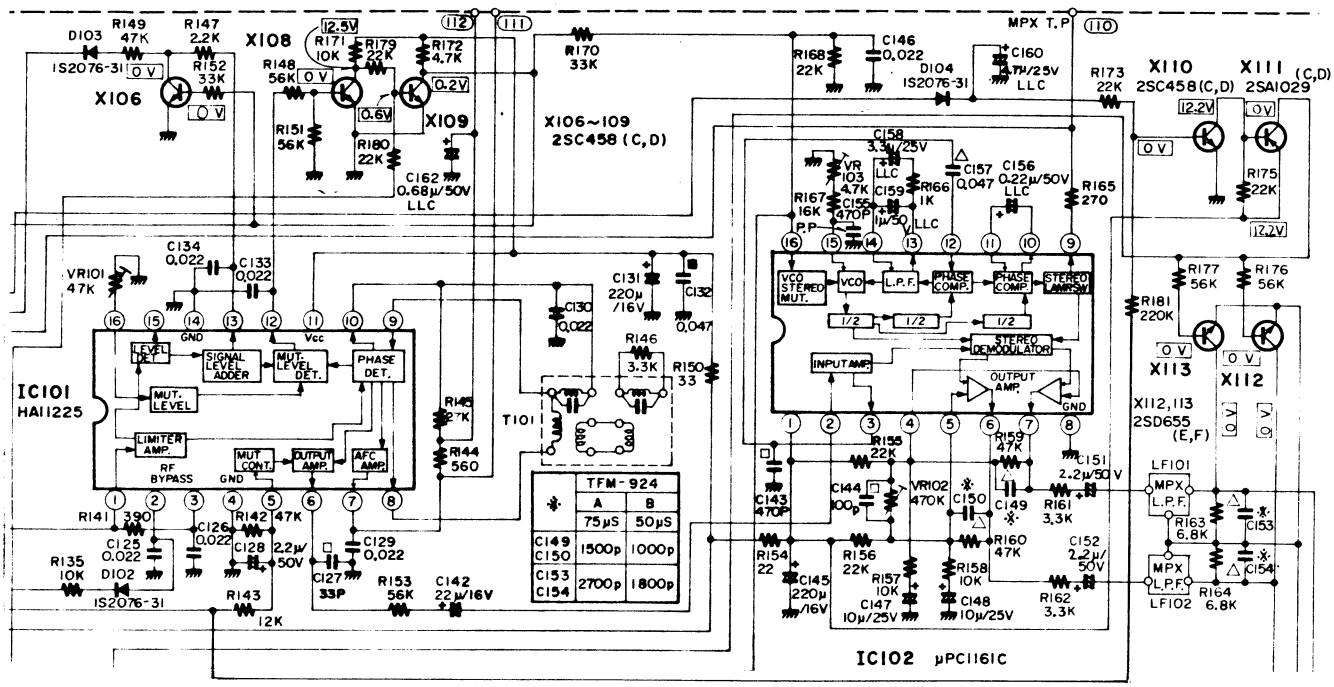


Fig. 30 FM Detector/MPX Demodulator Circuit

IC101: Limiter amplifier, phase detector, muting signal detector

IC102: MPX demodulator

X108, X109: Muting signal amplifier

X106: Muting switch for the signal level meter driving output.

X110, X111: Muting signal amplifier

X112, X113: Muting switch for FM audio output

VR101: Muting level adjustment

VR102: FM stereo separation adjustment

VR103: FM stereo detection VCO adjustment

IC101 Pin 2: Pins 1 and 2 are at the negative side of the differential input terminal.
At AM, when pin 2 enters into "L" level by D102, it supplies the muting signal to the internal amplifier.

IC101 Pin 5: Control terminal of phase-detected signal output.
This terminal is in the muting ON state when at "H" level.

IC101 Pin 6: Phase-detected signal output terminal

IC102 Pin 12: As shown in Fig. 31, its output becomes "L" when the station RF is accurately tuned in on. It becomes "H" at both sides of the station RF. Without the station RF signal, it becomes "M".

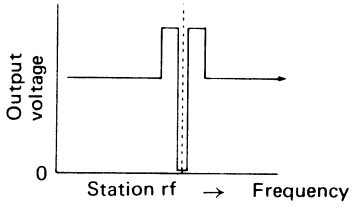


Fig. 31 IC101 Pin 12 Output Signal

IC102 Pin 13: Signal level meter driving output terminal
When the tuner tunes to a station RF, the terminal voltage rises with increase of the antenna input level.

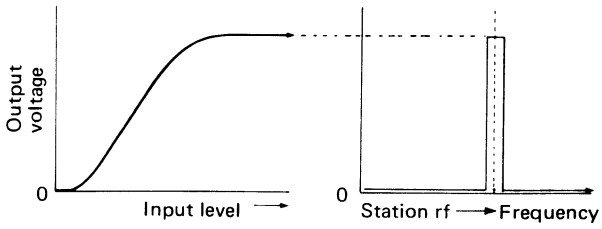


Fig. 32 IC101 Pin 13 Output Signal

X106: Switches the signal level indication signal emitted from pin 13 of IC101 by the signal emitted from pin 12 of IC101. Therefore, no signal indicator LED's light at the sides of the station RF. Only when the tuner accurately tunes to the station RF, they light. (Fig. 32)
In addition, this output signal functions to cease scanning.

X108, X109: Amplify the signal emitted from pin 12 of IC101. Concretely, this combination amplifies the "M" signal into on "H" signal. Accordingly, without station RF, this output is "H". Only when the tuner can accurately tunes to the station RF, it becomes "L".

2-2-3 AM Reception

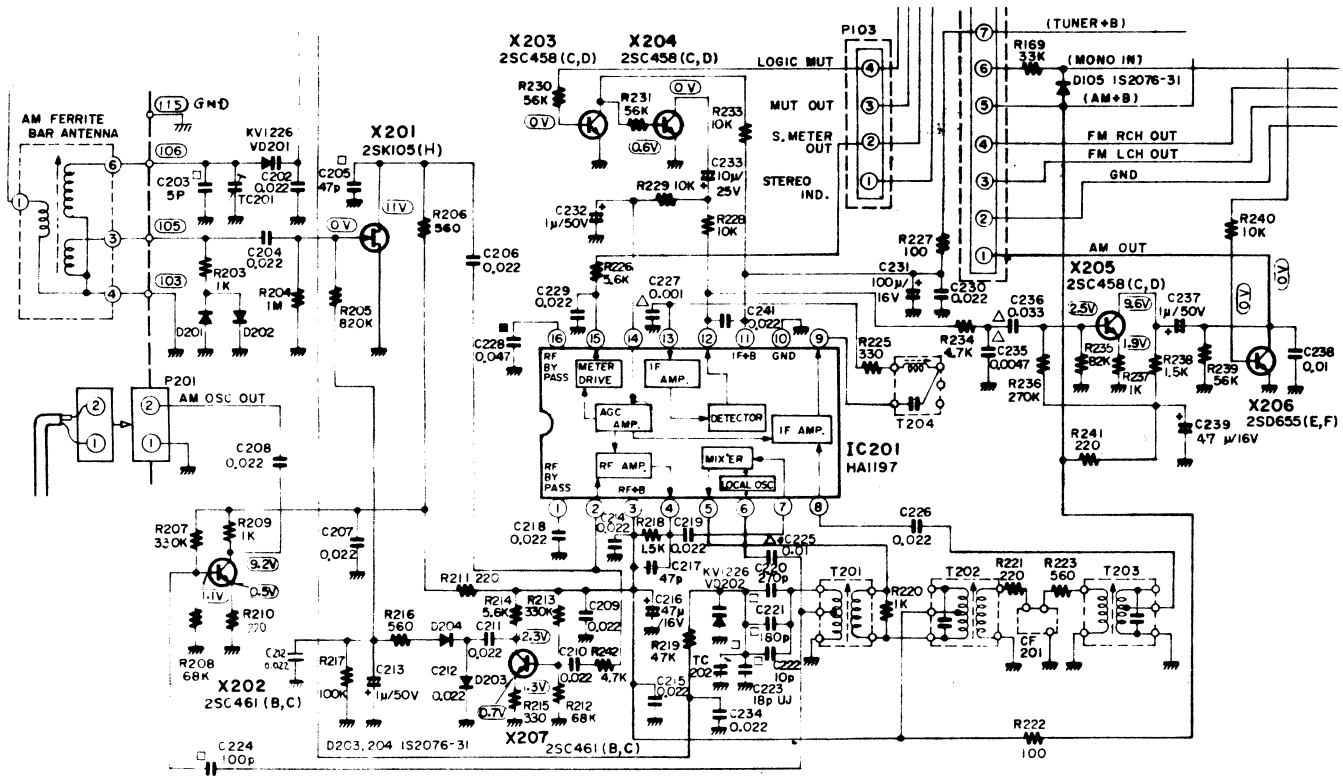


Fig. 33 AM Tuner Circuit

X201: RF amplifier
X202: Buffer amplifier of AM oscillation frequency
X203, X204: Function to change the AM AGC time constant. Usually, X204 is ON. When the tuner scans, X204 is OFF.
X205: AM output signal amplifier
X206: AM audio muting
X207: RF amplifier for AGC

2-2-4 Signal Meter and Divider

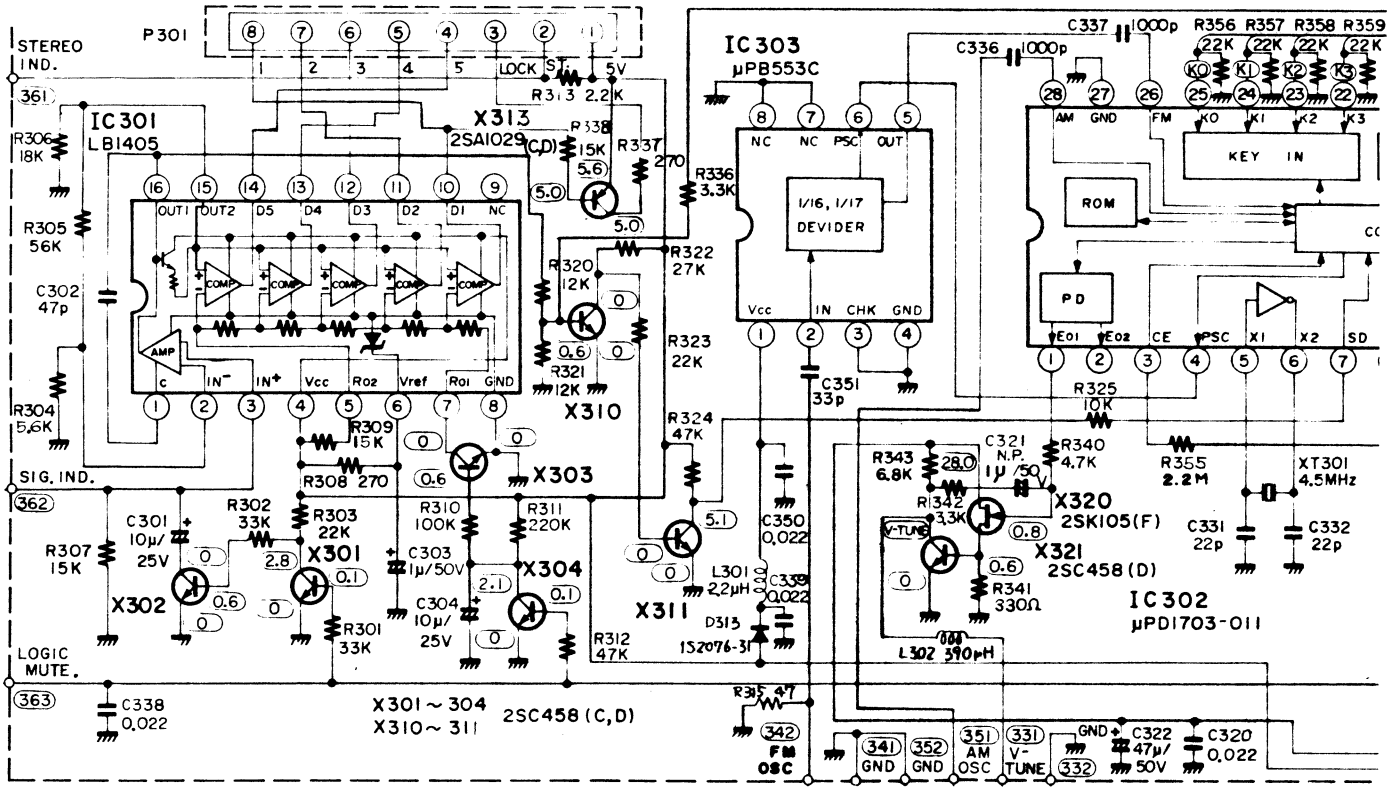


Fig. 34 LED Drive/Auto-scan Tuning Stop Circuit

IC301: Level comparison output for signal indicator LED's

IC301 Pin 3: Its input level rises with the electric field level of the antenna input terminals.

X301, X302: Functions to switch the time constant of the input signal of IC301.

X303, X304: Muting for signal indication
To extinguish the LED's during scanning, X303 goes OFF.

X310, X311: Amplfy the AUTO STOP signal.
By adding R336, the sensitivity is degraded to switch the AUTO STOP signal level.

X313: Locked LED radar drive

IC303: Prescaler of FM oscillation frequency

X320, X321: Charge pump amplifiers with active low pass filter

IC321: Controller

2-2-5 Controller IC302 (See T-X6 on page 30.)

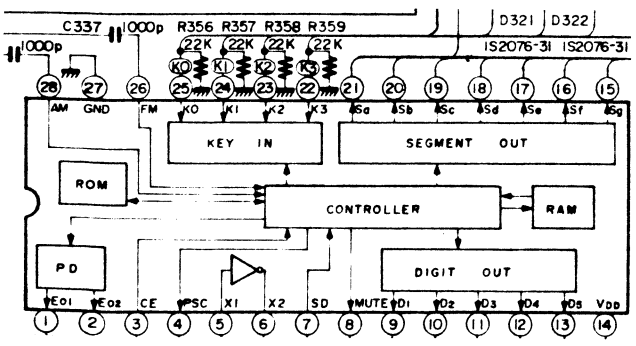


Fig. 35 Controller IC

Pin No.	Symbol	
1, 2	E01, E02 (Error OUT):	Output terminals of phase detector
3	CE:	Chip enable selection signal input terminal
4	PSC:	Prescaler control terminal
7	SD:	Input termianl for station detector
8	MUTE:	Output termianl: used to eliminate the static noise due to PLL lock deviation. This termianl emits an "H" signal when switching the FM band to the AM band or vice versa
9–13	D1–D5:	Digit signal output terminals
15–21	Sa–Sg:	Segment signal output terminals
22–25	K0–K3:	Input terminals of key return signal from external key matrix
26	FM:	Input terminal of prescaler output signal

2-2-6 Display Circuit

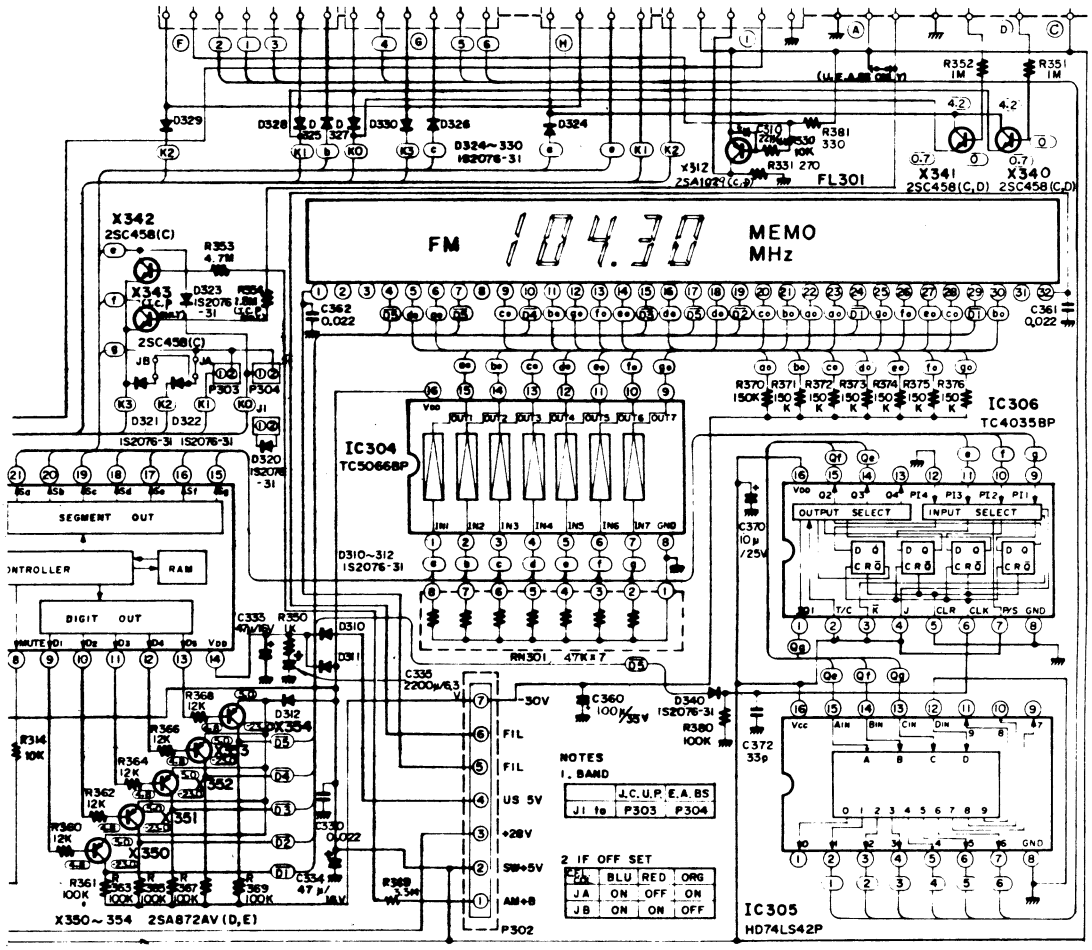


Fig. 36 FL Tube Drive Circuit

JA/JB: Jumpers for IF shift
X312: Scan LED drive
X340: Up Scan signal input amplifier
X341: Down Scan signal input amplifier
X342: Used to switch the display and the operation mode (FM/AM).
X343: Switch for AM 10 kHz display (Switches AM 10 kHz and 9 kHz.)
X350 – X354: Digit drive
IC306: Latch (See Q & A 4, below.)
P303, P304: With D320 connected to P303: 200 kHz steps (for U.S.A. and Canada)
With D320 connected to P304: 50 kHz steps (for U.K. and Europe.)
Without D320: 100 kHz steps (for others)

2-2-7 Q & A

Q1: Why are time constant switching circuits required?
A1: X203 and X204 function as the AM AGC time constant switch and X301 and X302 act as the signal level indicator time constant switch. The tuner operates the AM AGC function at a small time constant when it is scanning. In addition, the tuner positively performs the AUTO STOP operation at a small time constant of the signal level indication signal. This is because the signal level indication signal is used for AUTO STOP operation.
Q2: Why is a buffer amplifier needed for display?
A2: The buffer amplifier IC304(TC5066BP) improves tuner S/N ratio by reducing the load on IC302. Therefore, a S/N ratio of 80 dB is obtained from the dynamic drive system.
Q3: How is the preset memory backed up?
A3: C353 of 2200 μF provides residual current to the preset memory when the power is OFF (when the power plug is disconnected). The preset memory can be held at more than 3 V.
Q4: IC306 (TC3035BP) acts as the latch. What is its concrete operation?
A4: IC306 (TC3035BP) is used in the CH indication circuit. By this IC, the duty cycle is converted from about 0.01 sec to DC.
Q5: How is the display bias applied to the FL tube?
A5: This FL tube is ON when at "H" level. Namely, 3 V AC is supplied between pins 1 and 32 of the heater and a bias of -25 V is to the central point between them.

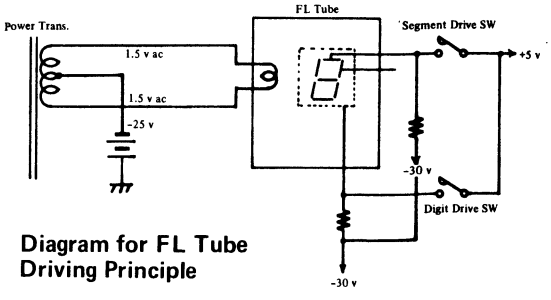


Fig. 37 Diagram for FL Tube Driving Principle

When both the digit and segment drive switches go ON, their associated display part lights.

2-2-8 Results of Test

X301:	B open	No particular phenomenon occurs.
	ON	Time constant switch: Normally, 10 μ/25 with C301.
X302:	B open	Not provided with the time constant switch, but in scanning, easily performs the AUTO STOP operation independent of C301. (These transistors are used for "L" level emission of the STOP signal coming from pin 16, without time lag.)
X303:	B open	The signal indicator does not go ON at any time.
	C-E short-circuited	The signal indicator flickers during scanning.
X311:	B open	The auto scanning operation does not work. Pin 7 is kept at +5.4 V.
	C-E short-circuited.	The AUTO STOP operation does not work.
X313:	B open	The locked radar does not go ON.
	C-E short-circuited	The locked radar remains ON.
X206:	B open	The AM/FM muting function does not operate. There is noise and signal when scanning.
	C-E short-circuited	There is no signal sound at AM.
X106:	B open	When the station is precisely tuned in, an "L" signal is emitted from pin 12 of IC101. Since this signal is used for AUTO STOP operation, when X106 is not in operation, the tuning stops even when the station RF is not exactly centered. In addition, the locked radar goes ON, even when it is at level 1 and the station RF is not precisely caught.
	C-E short-circuited	Neither the signal radar nor the locked radar go ON.
X109:	B open	Neither the signal radar nor the AUTO STOP operation go ON.
	C-E short-circuited	The muting function does not operate. When the station is precisly tuned in, the "L" signal from pin 12 of IC101 is emitted. X109 acts as the DC amplifier of this output signal. This case is the same as when C-E of X106 is open.
X110:	B open	This transistor does not operate in muting while scanning at AM and FM, but goes ON at FM. It goes ON and OFF depending upon the muting switch.
	C-E short-circuited	R811 and R812 generate heat. The muting function does not work at AM. The AUTO STOP operation does not work at AM and FM. No sound is produced at FM.
X111:	B open	The muting function does not work while scanning at AM and FM.
	C-E short-circuited	The muting operation does not go OFF at any time.
X312:	B open	The scan LED remains ON at AM and FM.
	C-E short circuited	The scan LED remains OFF at all times.
X340:	B open	Up-scan is impossible. The other actions are possible.
	C-E short-circuited	Up-scan is performed and the scanning operation is locked.
X341:	B open	Down-scan is impossible. But the other actions are possible.
	C-E short-circuited	The scanning operation is locked (after scanning). (However, when pressing the UP switch, this operation is performed.) The other actions do not change.
X342:	B open	FM display is impossible. The FM display is held and the frequency does not change.
	C-E short-circuited	FM display is impossible. As the signal output is switched, the AM display is possible.
X343:	B open	No particular phenomenon
	C-E short-circuited	At AM, the least significant digit lights. By pressing AM-5, the scan radar goes ON. By pressing AM-2 in the knob, the AM-3 LED lights.
X350:	B open	At FM, [MHz] , [MEMO] , and the tens kHz digit do not light. At AM, [kHz] and [MEMO] do not light.
	C-E short-circuited	[MEMO] , [MHz] , [kHz] , and the FM tens kHz digit remain ON at AM and FM.
X351:	B open	At FM, the hundreds kHz digit does not light. At AM, the units kHz digit does not light.
	C-E short-circuited	At FM, the hundreds kHz digit remians ON. At AM, the units kHz digit remains ON.
X352:	B open	At FM, the units MHz digit does not light. At AM, the tens kHz digit does not light.
	C-E short-circuited	At FM, the units MHz digit remains ON. At AM, the tens kHz digit remains ON.
X353:	B open	At FM, the tens MHz digit does not light. AT AM, the hundreds kHz digit does not light.
	C-E short-circuited	At FM, the tens MHz digit keeps ON. At AM, the hundreds Hz digit remains ON.
X354:	B open	At FM, [FM] , the hundreds MHz digit, and the comma do not light. At AM, [AM] and the thousands kHz digit do not light.
	C-E short-circuited	At FM, [FM] , [AM] , the hundreds MHz remains ON, but the station No. is not displayed. At AM, [FM] , [AM] , the thousands MHz digit and the comma remains ON, but the station No. is not displayed.

2-3 Frequency Synthesizer Tuner T-X6

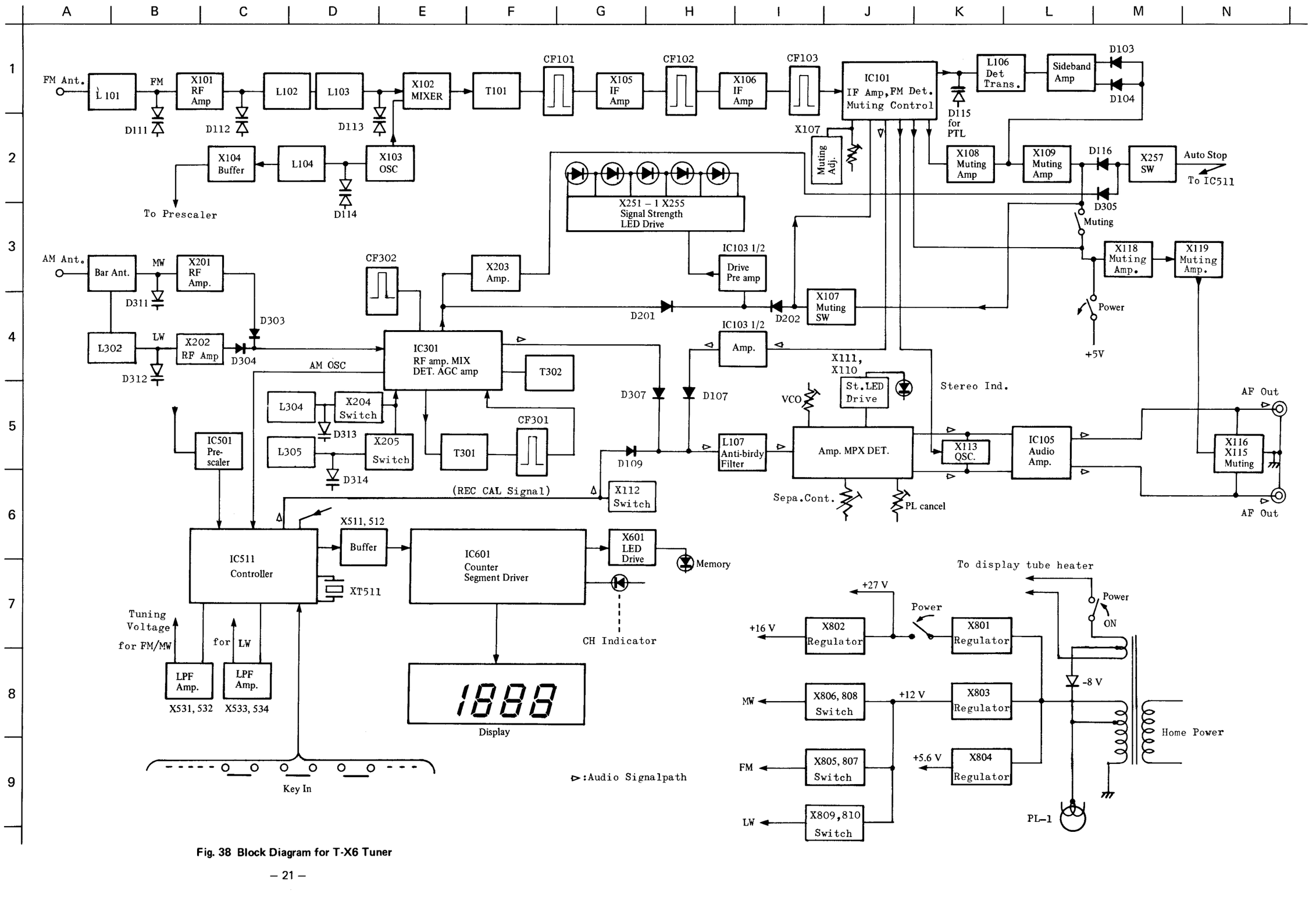


Fig. 38 Block Diagram for T-X6 Tuner

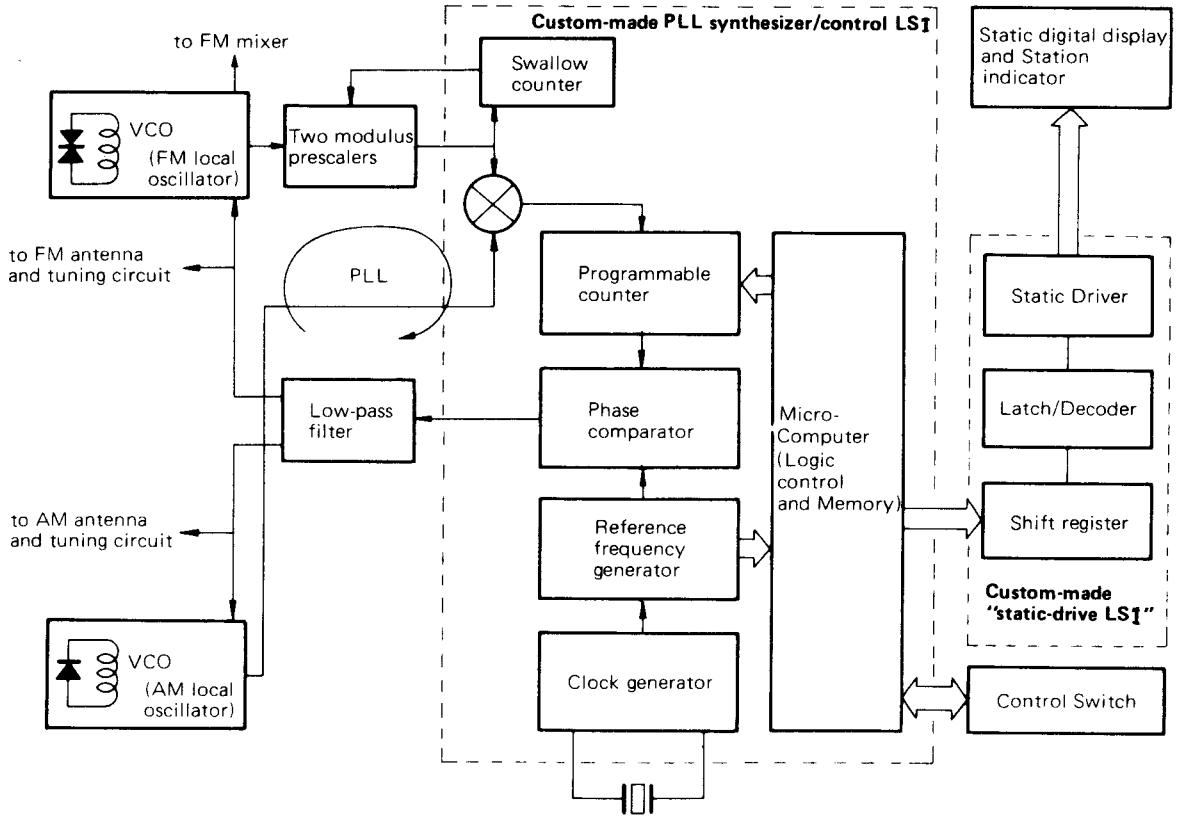


Fig. 39 Block Diagram of T-X6's Quartz-locked PLL Synthesizer Circuit

2-3-1 FM Reception

(1) FM tuner section

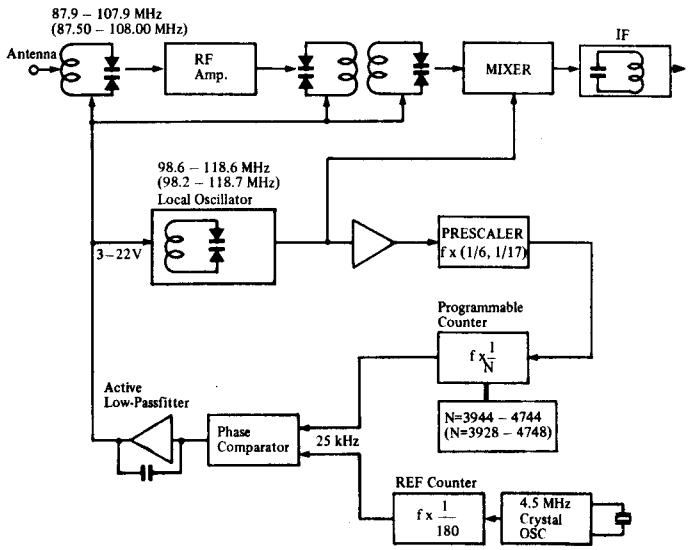


Fig. 40 Circuit Outline on FM Reception

For example, the received signal is;

a) 87.9 MHz OSC frequency = 3944 x 25 kHz
= 98.6 MHz

b) 88.05 MHz OSC frequency = $(3928+\frac{550\text{ kHz}}{25\text{ kHz}})\times 25\text{kHz}$
= 98.75 MHz

c) 88.1 MHz OSC frequency = $(3944+\frac{200\text{kHz}}{25\text{ kHz}})\times 25\text{kHz}$
= 98.8 MHz

(2) FM tuner circuit

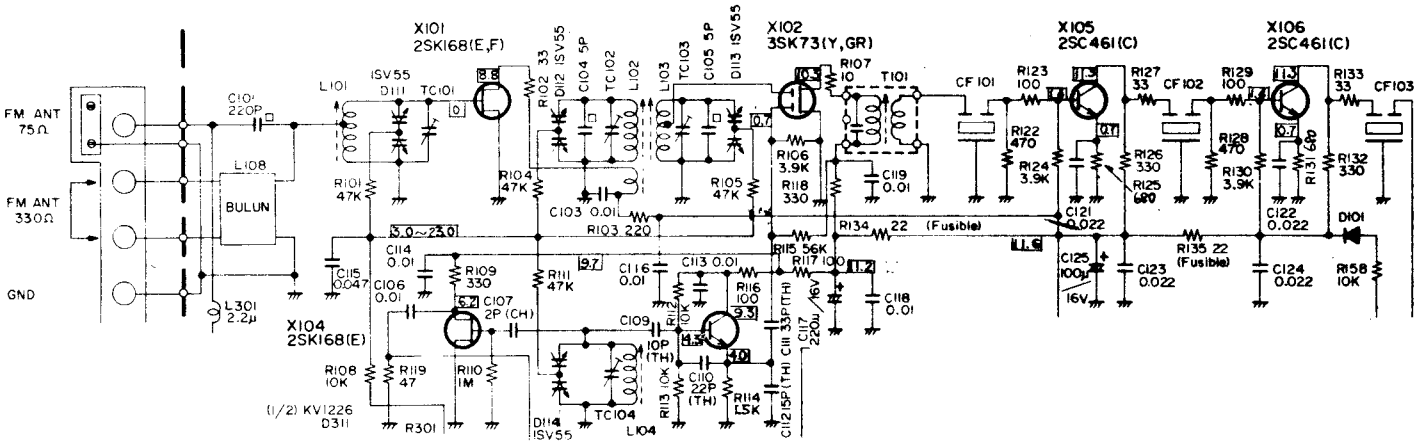


Fig. 41 FM Front-end IF Amplifier Circuit

X101:	FM high frequency amplifier
X102:	FM mixer
X103:	FM local oscillator
X104:	FM buffer amplifier of local oscillation frequency
X105, X106:	FM IF amplifiers
CF101, CF102, CF103:	10.7 MHz ceramic filters
D101:	Noise muting of IC101 while AM receiving when Pin 2 of IC101 enters into "L" level by this diode at AM.

(3) FM detector and muting circuit

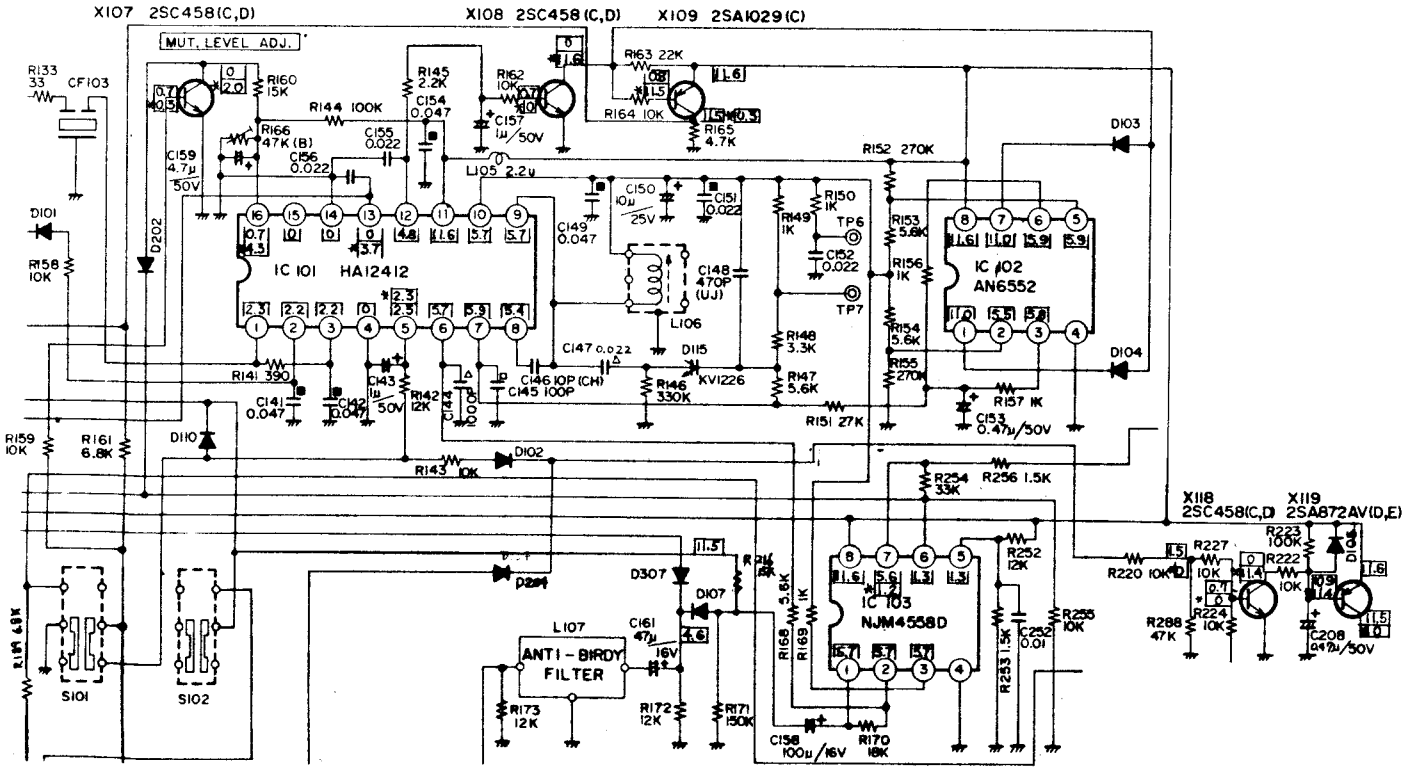


Fig. 42 FM Detector/Zero-cross Switch Circuit

IC101:	IF amplifier, limiting amplifier, FM detector, signal level detector, muting level control
X107:	Muting level switch
X108:	Muting signal amplifier
X109:	Muting level/signal amplifier when the station is precisely tuned in and for the AUTO STOP operation when auto-scan tuning.
X118, X119:	Muting switch for audio output signal

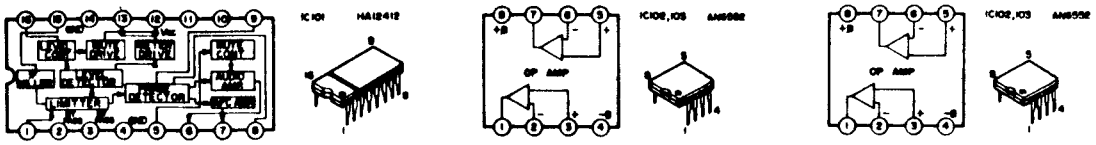


Fig. 42-1 IC101, 102, 103

2-3-2 Explanation of IC101 Operation

(1) Detection output

Emitted from pin 6. The signal entered in pin 1 is amplified, sufficiently processed in the limiter and PTL detected.

(2) Signal meter (indicator) drive signal

Emitted from pins 13 and 16. In the T-X6, this signal (from pin 13) is used for the QSC (Quieting Slope Control) drive signal.

Fig. 43 shows input signal level vs pin 13 output voltage characteristics.

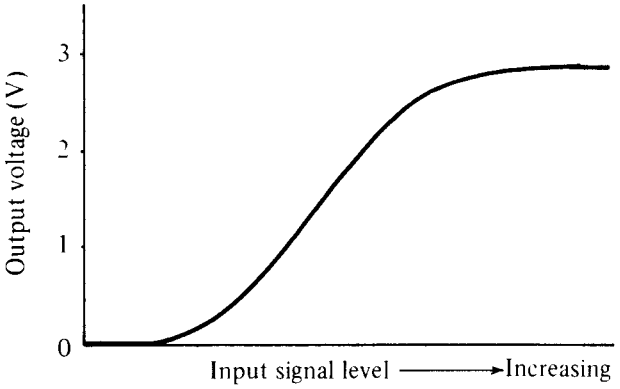


Fig. 43 IC101 Pin 13 Output Signal

(3) Muting signal

Emitted from pin 12. This signal level changes from "H" to "L" according to the input signal level. This changing point varies by the external resistor of pin 16. (See Fig. 44.)

Next, X108 inversion-amplifies this signal (Fig. 45) which in turn is inversion-amplified in X109 again.

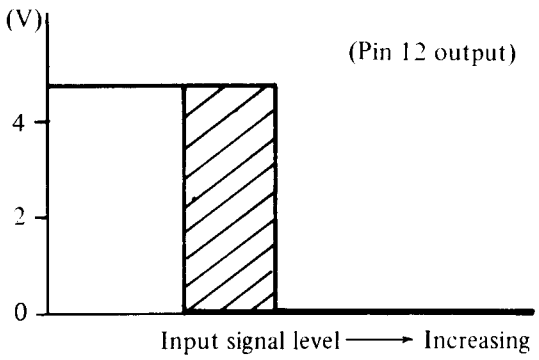


Fig. 44 IC101 Pin 12 Output Signal

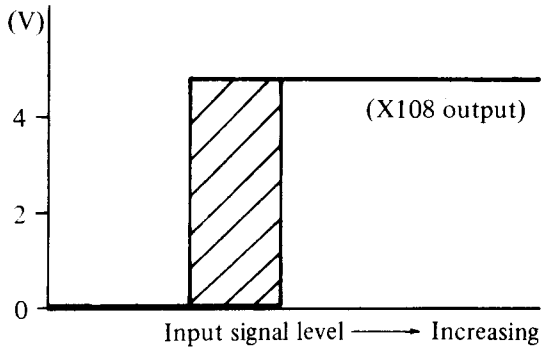


Fig. 45 X108 Collector Output Signal

This signal is applied to pin 5. At this time, if it is "H", the muting operation goes ON, while if it is "L", the muting operation goes OFF. When the tuner is arranged so that the muting operation goes ON and OFF only by that signal which varies according to the input signal level, it is undersirable that the muting operation goes OFF at the side bands of the station RF while auto-scan tuning.

The side band component is amplified in IC102 and detected for "L" level by D103 and D104. Further, the muting signal is superimposed on the side band component to protect the muting operation from going OFF.

IC102, which is a zero-cross switch, detects exactly the tuning point. This IC is also used to perform the muting operation when detuning and to accurately perform AUTO STOP operation.

2-3-3 Muting Circuit

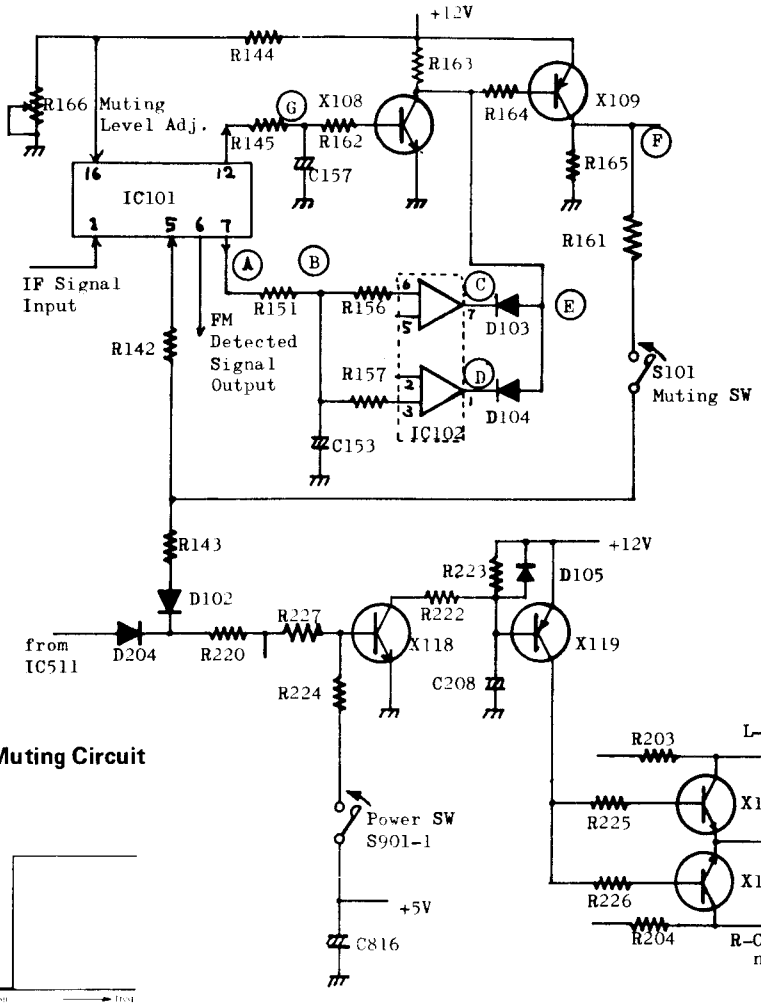
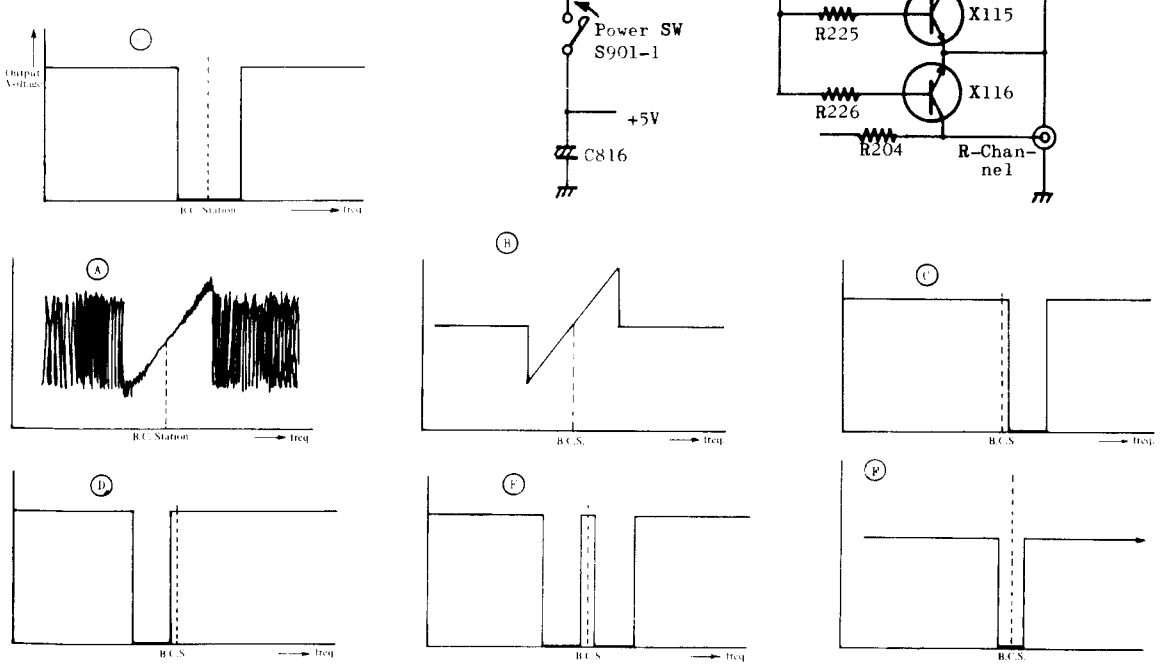


Fig. 46 Muting Circuit



(1) Muting operation

The muting signal with the signal from pin 12 shown in Fig. 44 is amplified in X108 and X109 and applied to X118 through S101.

When receiving: X108 OFF → X109 OFF → X118 OFF → X119 OFF → X115, X116 OFF (open)
When the "L" signal is applied to pin 5, the demodulation signal is emitted from the output terminal.

When at inter-station: X108 ON → X109 ON → X118 ON → X119 ON → X115, X116 ON (short-circuit)
When the "H" signal is applied to pin 5, the muting operation goes ON.

When the power switch is OFF: S901-1 ON → X118 ON → X119 ON → X115, X116 ON (short-circuit)
When the output terminal is short-circuited by X115 and X116, the output signal is muted.

When detuning: S-curve signal Ⓐ is emitted from pin 7. This signal is amplified in the negative and positive portions of the S-curve separately at IC102. When bias is applied to the respective amplifiers, output Ⓒ or Ⓓ is obtained. Subsequently, this output is rectified by D103 and D104 and becomes "L" when detuning (See Ⓔ).
Signal Ⓖ from pin 12, after inversion-amplification, is superimposed on signal Ⓔ. The signal resultant from this superimposition is further inversion-amplified by X109 and output waveform Ⓕ is thus obtained.
Signal Ⓕ means that the muting signal level changes from "H" to "L" only when the station RF and the reception frequency are equal.

When tuning by auto-scanning: The "H" signal is emitted from terminal MUT (pin 8) of IC511 when auto-scan tuning. When this signal passes D204, X118 goes ON, X119 ON, and X115 and X116 ON (in this order).
Thus, the output signal is muted.

2-3-4 FM Signal Strength Indicator

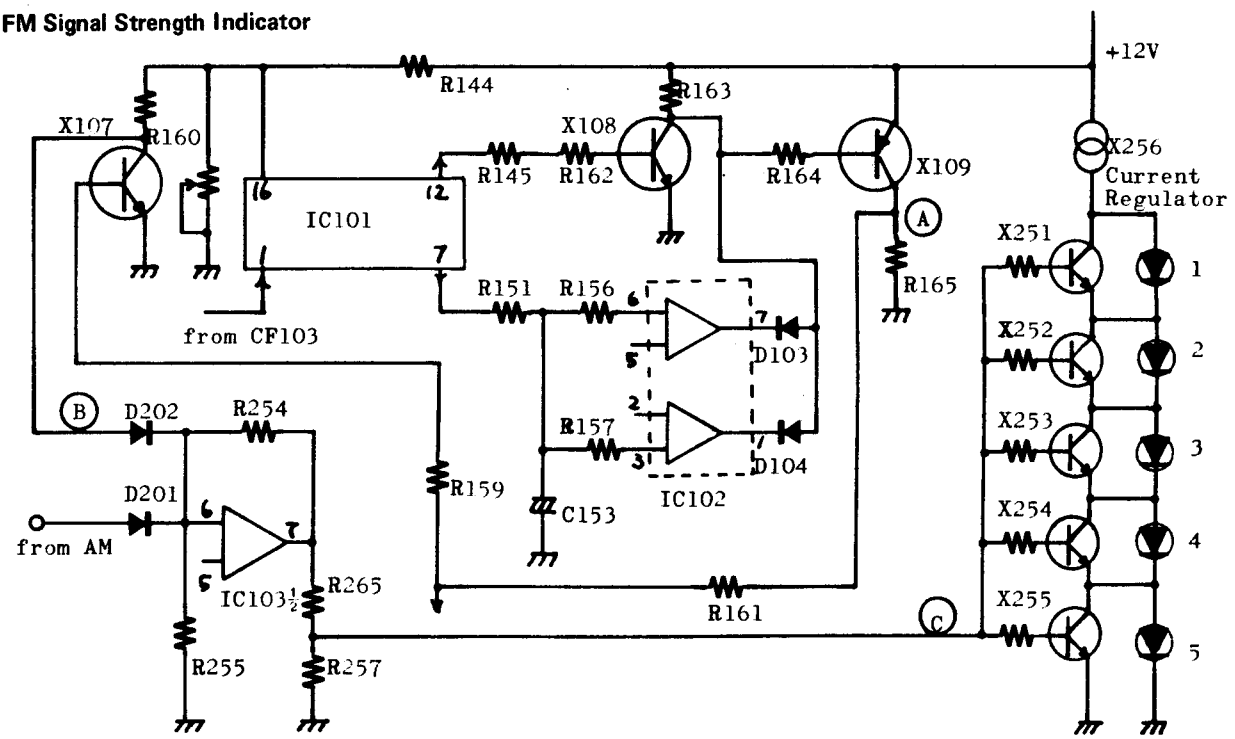
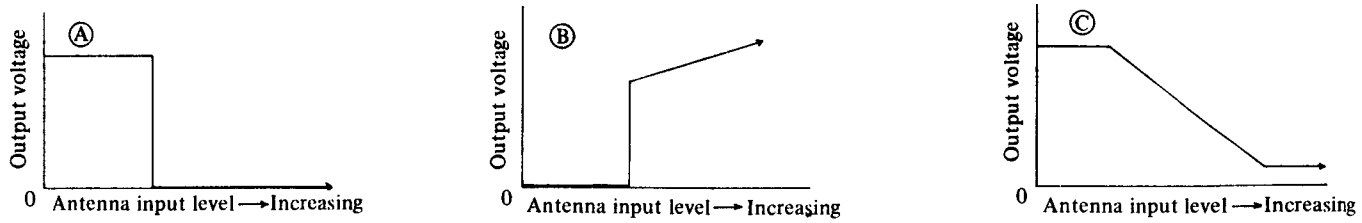


Fig. 47 Signal Strength Indicator LED Drive Circuit



The display in the signal strength indicator must vary according to the change of the antenna input level. The signal in Ⓐ is the collector output voltage of X109 when it is tuned to the station RF. This output voltage varies from "H" to "L" with the increase of the antenna input level. The signal in Ⓑ results from the superimposition of the output signal of pin 16 on the signal resultant from the inversion-amplification of the signal in Ⓐ by X107. The increase from the "ON" level is due to the output of pin 16. The signal in Ⓒ results from the amplification of the signal in Ⓑ by IC103. The signal in Ⓒ is inversion-amplified with pin 6 as the input terminal.

The indicator LED's go ON in the serial order of LED 1 to LED 5. Without the antenna input, the LED's do not light because the voltage in Ⓒ is high and X251 – X255 go ON. With a small antenna input, the voltage level in Ⓒ drops slightly, thus turning X251 OFF. The current thereby flows into LED 1 to light.
When the voltage in Ⓒ is reduced in this manner, transistors X251 – X255 go OFF in serial order and LED's 1 – 5 light.

2-3-5 REC CAL (Recording Level Calibrator) Operation (for U.S.A. and Canada)

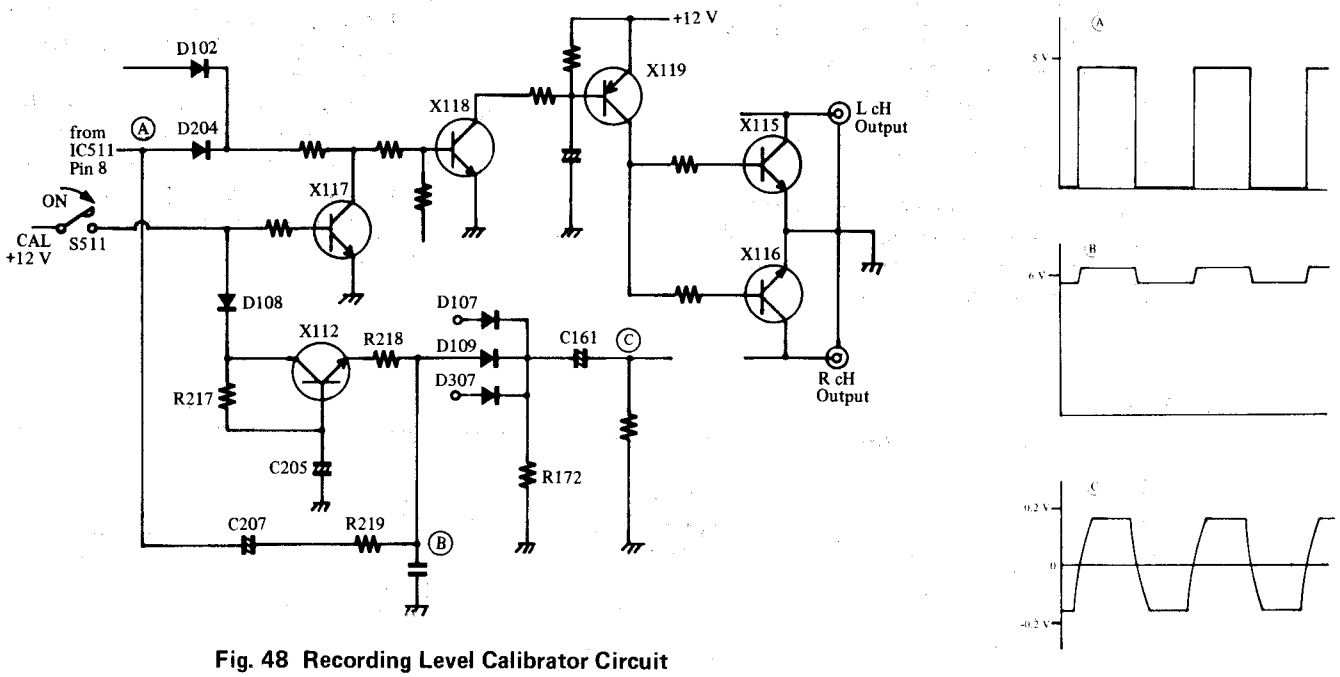


Fig. 48 Recording Level Calibrator Circuit

When IC511 (μPD1703C-014) switches ON terminals K3 and Sf, a pulse of 333 Hz is emitted from terminal MUT (pin 8). When scanning, terminal MUT becomes "H" to turn X115 and X116 ON. When calibrating the recording level, a square wave as shown in Ⓐ appears. Further, since S511 is turned ON at this time, X117 goes ON, X118 OFF, X119 OFF and, X115 and X116 OFF (in this order). In addition, X112 is a delay circuit which goes ON at the time constant of R217 and C205 to prevent noise generation during switching.

The signal in Ⓐ passes C207 and is voltage divided by R219, R218 and C206 and is shifted by the output voltage from X112. The DC component of the signal in Ⓑ is removed when passing C161, thus resulting in the signal in Ⓒ.

2-3-6 FM Stereo Demodulator, QSC and Output Amplifier

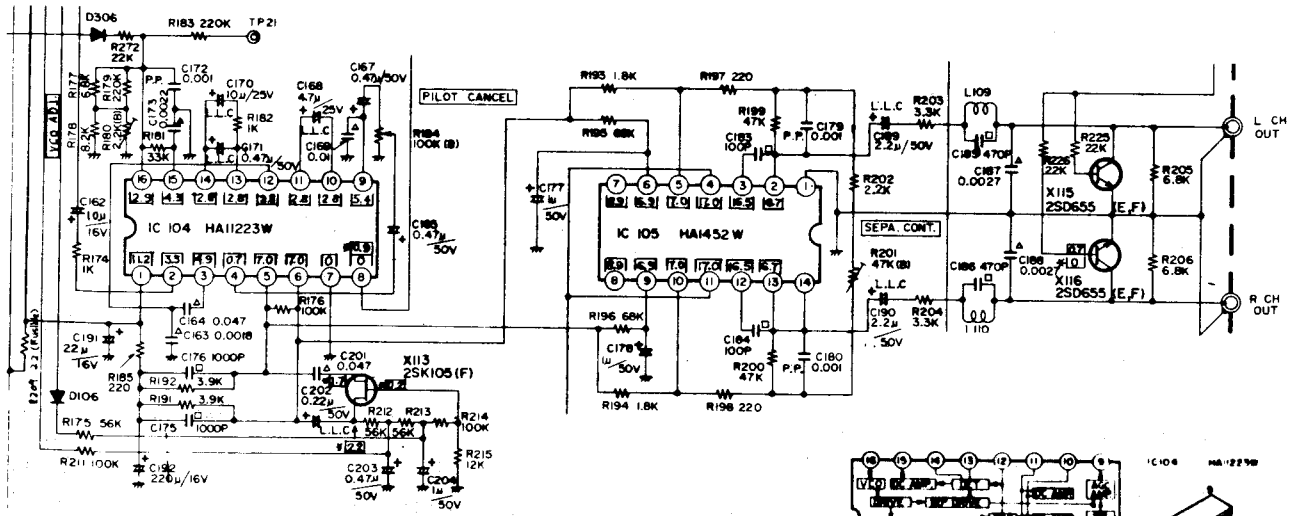


Fig. 49 FM Demodulator/QSC/Output Amplifier Circuit

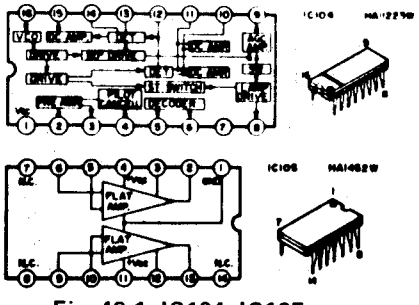


Fig. 49-1 IC104, IC105

IC104 is the FM stereo demodulator and pin 16 is the terminal for adjusting 76 kHz VCO. At AM, by making pin 16 "H" by D306, the operation of VCO is stopped to prevent noise generation. VR R184 is the leak cancel VR of pilot carrier.

- **QSC (Quieting Slope Control) operation**

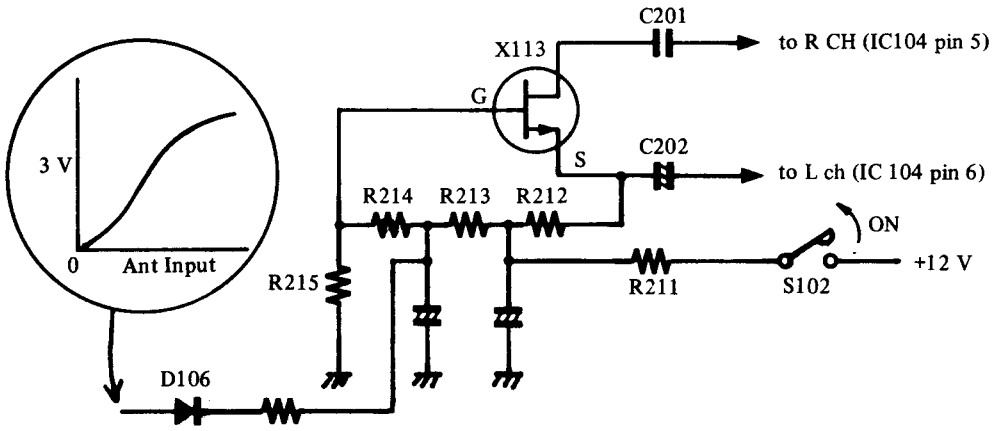


Fig. 50 QSC Circuit

Stereo FM broadcasts are far more susceptible to noise than monophonic ones, particularly when the signal is weak. The QSC automatically adjusts the amount of high-frequency mixing (Left with Right channels), depending on the strength of the broadcast. Stereo FM sound quality is improved.

With a low antenna input level from a stereo broadcasting station, the output voltage from pin 13 of IC101 is low. The bias of X113 for which this output voltage is used goes ON to offset the anti-phase noise in Lch and Rch.
In addition, when the QSC is OFF, S102 goes ON. Thus, sufficient bias voltage is supplied to X113 which is in turn open.

2-3-7 Source Selection Circuit

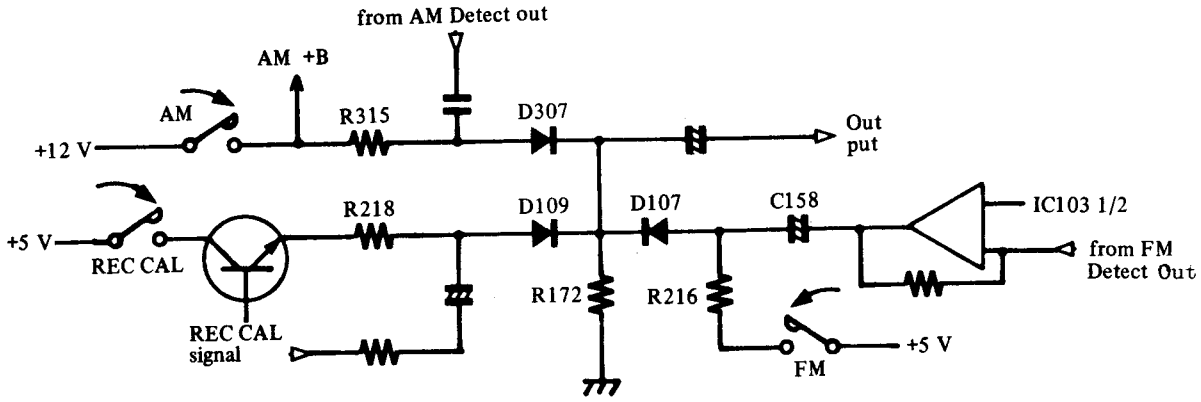


Fig. 51 Source Selection Circuit

The tuner enters into the FM mode by switching ON terminals K2 and Sd of IC511. At this time, a switching function for both FM tuner operation and detection signal output is required. To meet this requirement, the switching is performed by using the high resistance in reverse bias and the low resistance in forward bias.

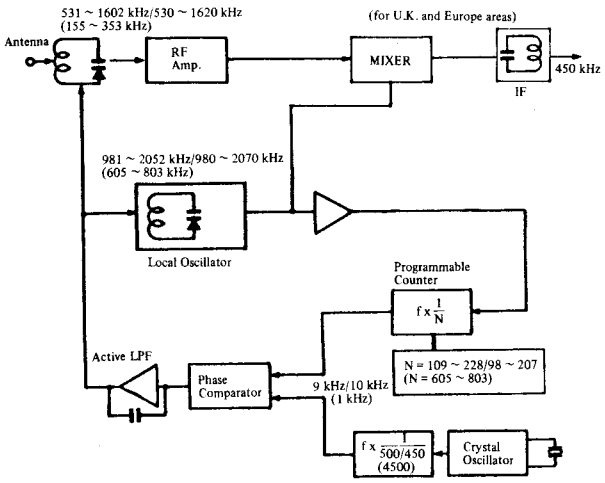


Fig. 52 Circuit Outline on AM Reception

For example, the received signal is;

a) 531 kHz OSC frequency = 109 x 9 kHz = 981 kHz

b) 540 kHz OSC frequency = $(109 + \frac{9\text{ kHz}}{9\text{ kHz}}) \times 9\text{ kHz}$

= 990 kHz (9 kHz step)

$(98 + \frac{10\text{ kHz}}{10\text{ kHz}}) \times 10\text{ kHz}$

= 990 kHz (10 kHz step)

c) 549 kHz OSC frequency = $(109 + \frac{18\text{ kHz}}{9\text{ kHz}}) \times 9\text{ kHz}$

= 999 kHz

2-3-8 AM Reception

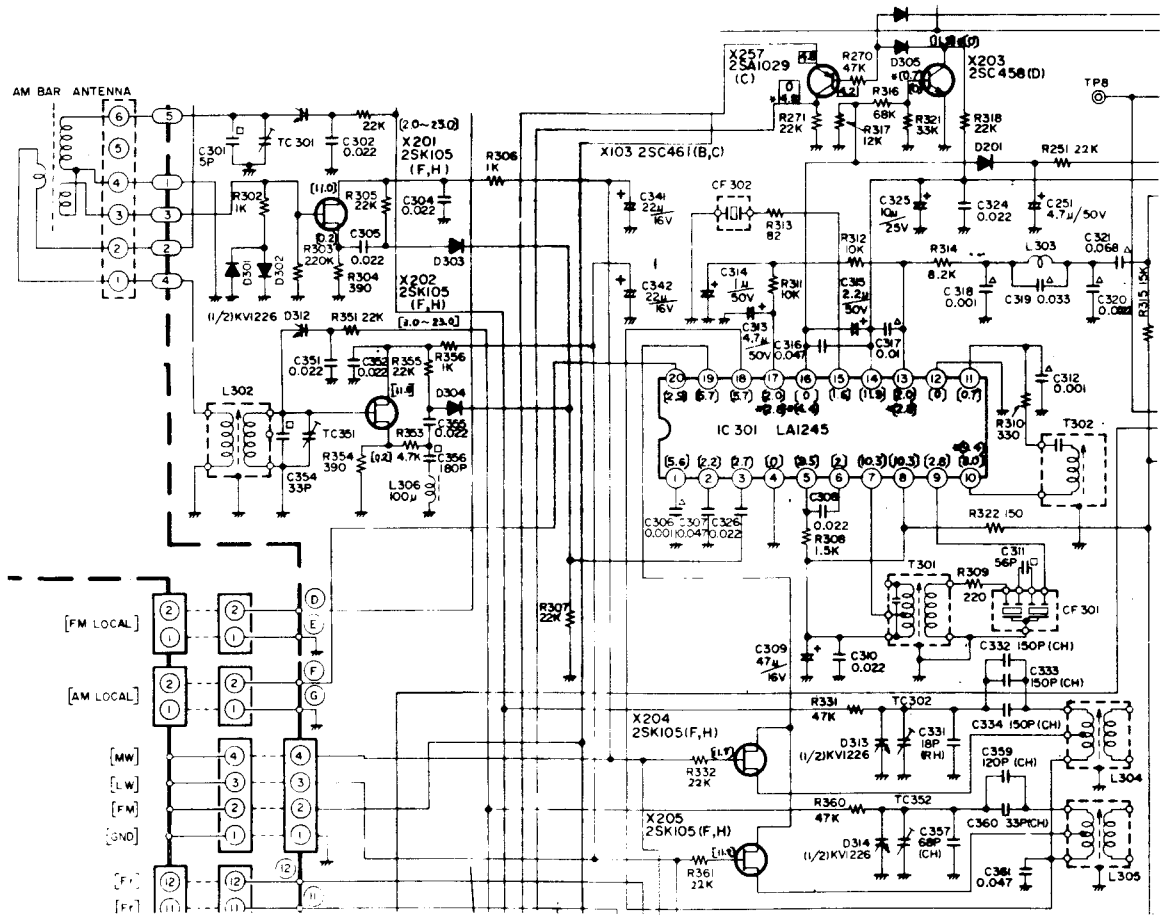


Fig. 53 AM Tuner Circuit

X201 (X202): MW (LW) RF buffer amplifier
The FET emits the signal from its source. It is used to improve sensitivity and distortion rate against strong electric fields by reducing the load on the antenna coil.

D303, D304 (L type only): These diodes switch the MW signal to the LW signal or vice versa.

X204, X205 (L type only): Changeover switch of local oscillator
The oscillation coil is switched over by the bias voltage applied to the gates.

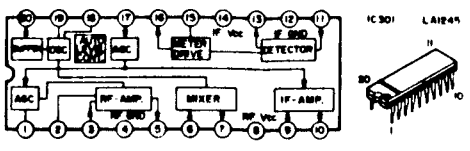


Fig. 53-1 IC301

IC301 pin 16: The output terminal whose level varies with the strength of the antenna input electric field.
It drives X203 to produce the STOP signal of auto tuning operation. Its output signal is amplified by IC103 to drive the signal indicator LED's.

X203: AM STOP signal amplifier for auto-scan tuning operation
It inversion-amplifies the "L" AUTO STOP signal and applies its resultant "H" signal to terminal Sd of IC511.

L303, C319: These act as the trap circuit. Their tuning frequency is 9 kHz and is used to prevent the beat noise from stations 9 kHz away from the tuned station.

2-3-9 Controller

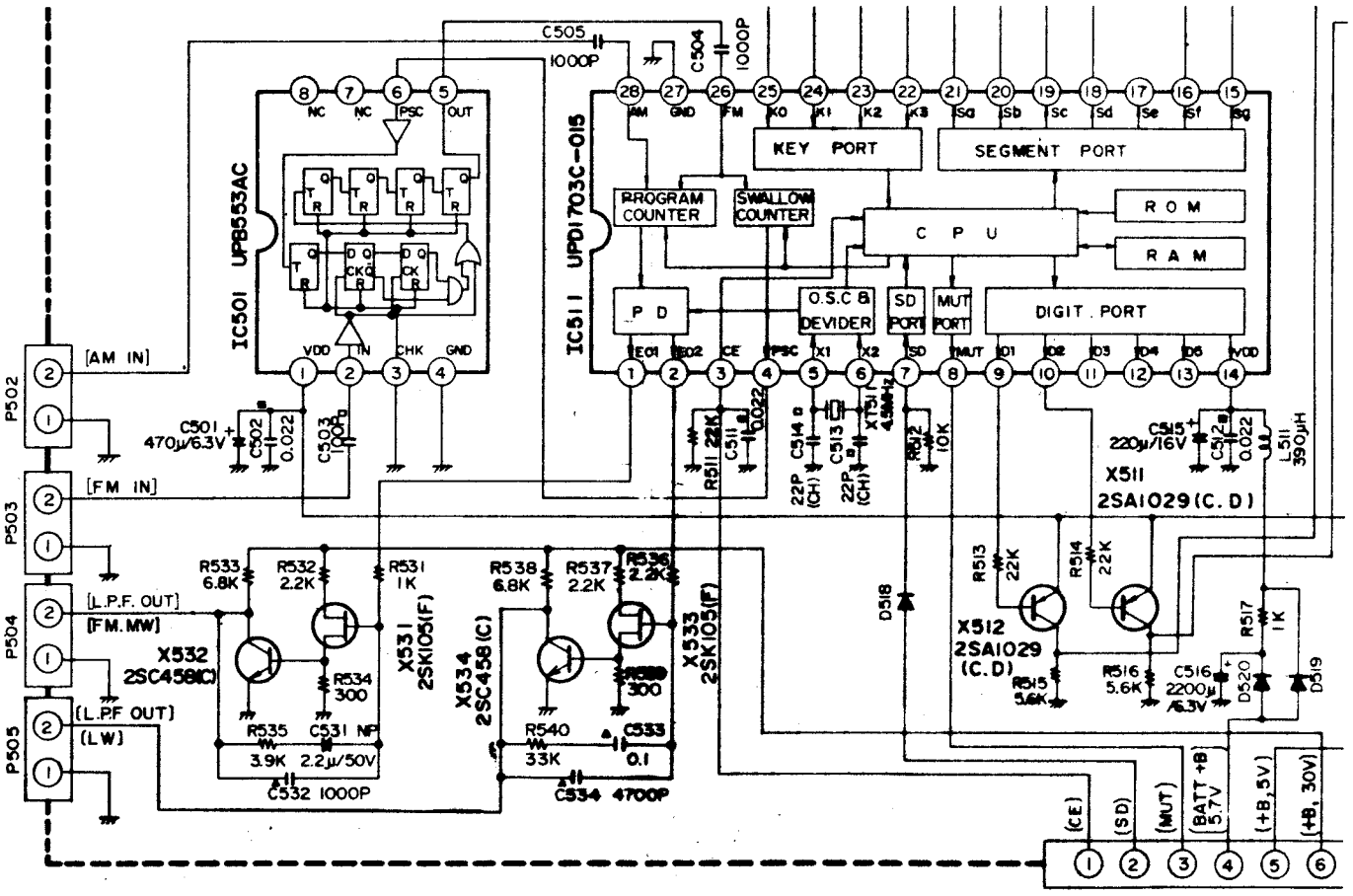


Fig. 54 Controller/LPF Circuit

IC501: Prescaler of FM oscillation frequency (division ratio: 1/16, 1/17)

X531, X532: FM/MW charge pump amplifiers with LPF's

X533, X534: LW charge pump amplifiers with LPF's

X511, X512: Digit signal buffer amplifiers

Note: Operation and effect of this circuit is shown on page 33.

IC511: Controller

Pin No.	Symbol	Definition
1	E01	Phase detection signal output terminals
2	E02	When the division of the oscillation frequency is higher than the reference frequency, their outputs are "H". Conversely, when it is lower than the reference frequency, they are "L". However, when it coincides with the reference frequency, their output levels float.
3	CE	Chip enable selection signal input terminal. By making its input level "L", the preset memory is backed up, thus permitting low power comsumption of less than 10 μA.
4	PSC	Prescaler control terminal: emits the signal to switch the division ratio of the prescaler.
5	X1	4.5 MHz crystal oscillation frequency input terminals
6	X2	
7	SD	Input terminal for station detector: used to detect the station reception while auto-scan tuning. When an "H" level signal is applied to this terminal, the auto-scan tuning will be stopped.

8	MUT	Output terminal: used to eliminate the static noise due to PLL lock deviation. During auto-scan tuning and when switching from one band to another, the high level output signal "H" appearing at this pin is used for the muting control signal. Note: "REC CAL" signal (333 Hz) appears on this pin when REC CAL switch is depressed. (REC CAL: designated for U.S.A. and Canada.)
9	D1	Digit signal output terminals for frequency display
10	D2	
11	D3	
12	D4	
13	D5	
14	V_{DD}	Power terminal for +5 V or ±0.5 V application
15	Sg	Segment signal output terminals for frequency display
16	Sf	
17	Se	
18	Sd	
19	Sc	
20	Sb	
21	Sa	
22	K3	Key matrix input terminals
23	K2	
24	K1	
25	K0	
26	FM	FM programmable counter input terminal
27	GND	Ground terminal for LSI
28	AM	AM programmable counter input terminal

- **Actual values of IC511 I/O signals**
  Pin 26 (FM): 1.5 Vp-p
  Pin 28 (AM): 1 Vp-p
  Pin 4 (PSC): 5 Vp-p

- **Relationship between reception frequency and tuning voltage**

Band	frequency	LPF output voltage
FM	88.1MHz	about 3 volt
	106.5MHz	about 20 volt
MW	666kHz	about 5 volt
	1521kHz	about 20 volt
LW	164kHz	about 4 volt
	326kHz	about 17 volt

Table-1

- **Relationship between PSC signal and reception frequency (In FM reception only)**

When "88.1 MHz" or "106.5 MHz" is displayed.

When "107.7 MHz" or "87.7 MHz" is displayed.

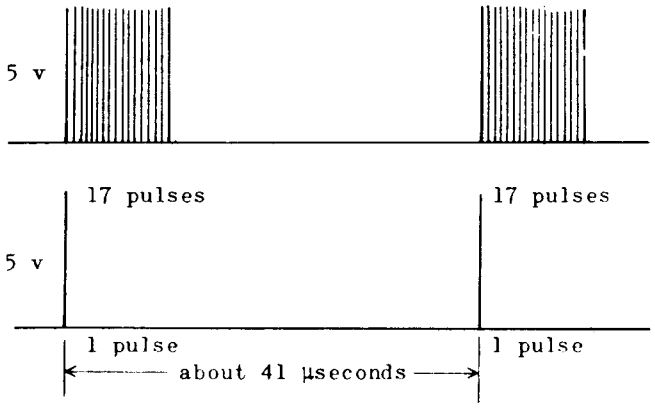


Fig. 55 PSC Signal

As shown above, the number of pulses in the PSC signal rises from 1 to 31 pulses in increments of 2 pulses, returns to 1 pulse and rises again.

- **IC601 terminal voltage without presetting operation**

Measured by	10 MΩ CRT	Tester 50 kΩ/V	CRT	Tester	CRT	Tester
IC 601	FM 88.1M	←	AM 540	←	LW 200 k	←
Pin 1	5 V	4.8 V	5 V	4.9 V	5.0 V	4.9 V
2	0 V 4.5 at M	0/4	0/4.5	0/4.2	0/4.4	0/4.0
3	-7.5	-6.8	-7.5	-6.9	-7.5	-6.8
4	4.7	4.6	4.8	4.7	4.8	4.6
5	4.8	4.7	4.8	4.8	-7.5	-5.9
6	4.8	4.6	-7	-6.4	4.8	4.6
7	4.8	4.6	4.8	4.7	4.8	4.6
8	4.8	4.6	4.8	4.6	-7	-6.4
9	4.8	4.6	4.8	4.6	4.7	4.6
10	4.8	4.6	-7	-6.1	4.7	4.6
11	4.8	4.6	-7.2	-6.3	4.8	4.6
12	4.8	4.6	4.8	4.7	4.8	4.7
13	4.8	4.6	-7.2	-6.5	4.8	4.6
14	4.8	4.6	-7	-6.3	4.8	4.6
15	4.8	4.6	4.7	4.6	4.7	4.6
16	4.8	4.6	4.8	4.6	-7.5	6.6
17	4.8	4.6	4.8	4.7	4.8	4.6
18	-7	-6.2	4.8	4.7	4.8	4.7
19	-7	-6	4.8	4.7	4.8	4.6
20	-7	-6.6	4.8	4.7	4.8	4.6
21	-7	-6.4	4.8	4.7	4.8	4.6
22	4.7	4.6	4.8	4.7	4.8	4.6
23	-7.5	-7	-7.5	-7.0	-7.5	-6.8
24	4.7	4.6	4.8	4.7	4.7	4.6
25	(-7.5) 4.8	(-7) 4.6	-7	-6.4	-7	-6.4
26	-7	-5	-7	-5.2	-7	-5.4
27	3.4	3.2	-8.5	-7.8	-8	-8
28	-8.5	-7.2	3.7	3.6	0	0
29	(0) -8	(0) -7.5	0	0	3.7	3.6
30	-8	-7	-7	-7	-7.5	-7.0
31	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	5	4.8	5	4.8	4.8	4.8
38	0	0	0	0	0	0
39	Pulse 5/0	1	Pulse 5/0	1	Pulse 5/0	1
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0

NOTE: ( ) is for U.S.A. and Canada

Table-2 IC601 Terminal Voltage without Presetting Operation

- **IC511 segment signal output waveforms for frequency display**

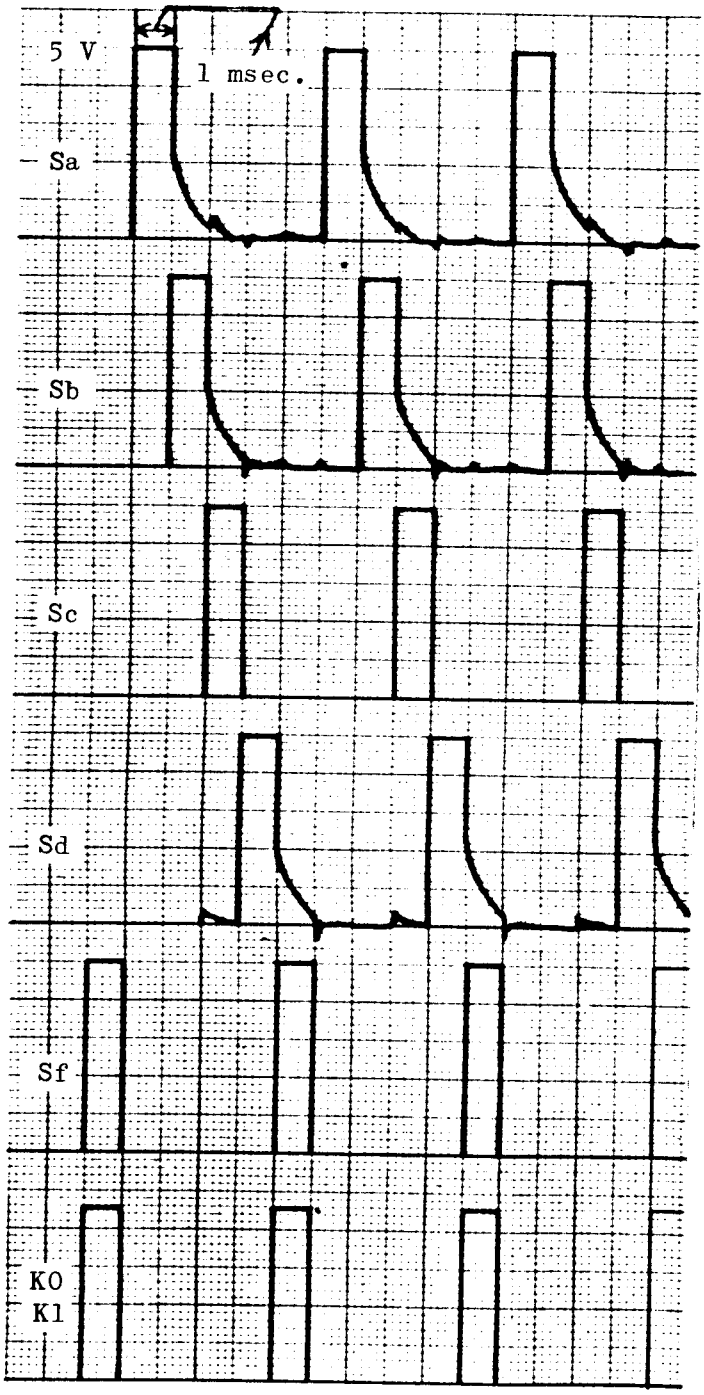


Fig. 56 IC511 Segment Drive Output Waveforms

- **Frequency display**

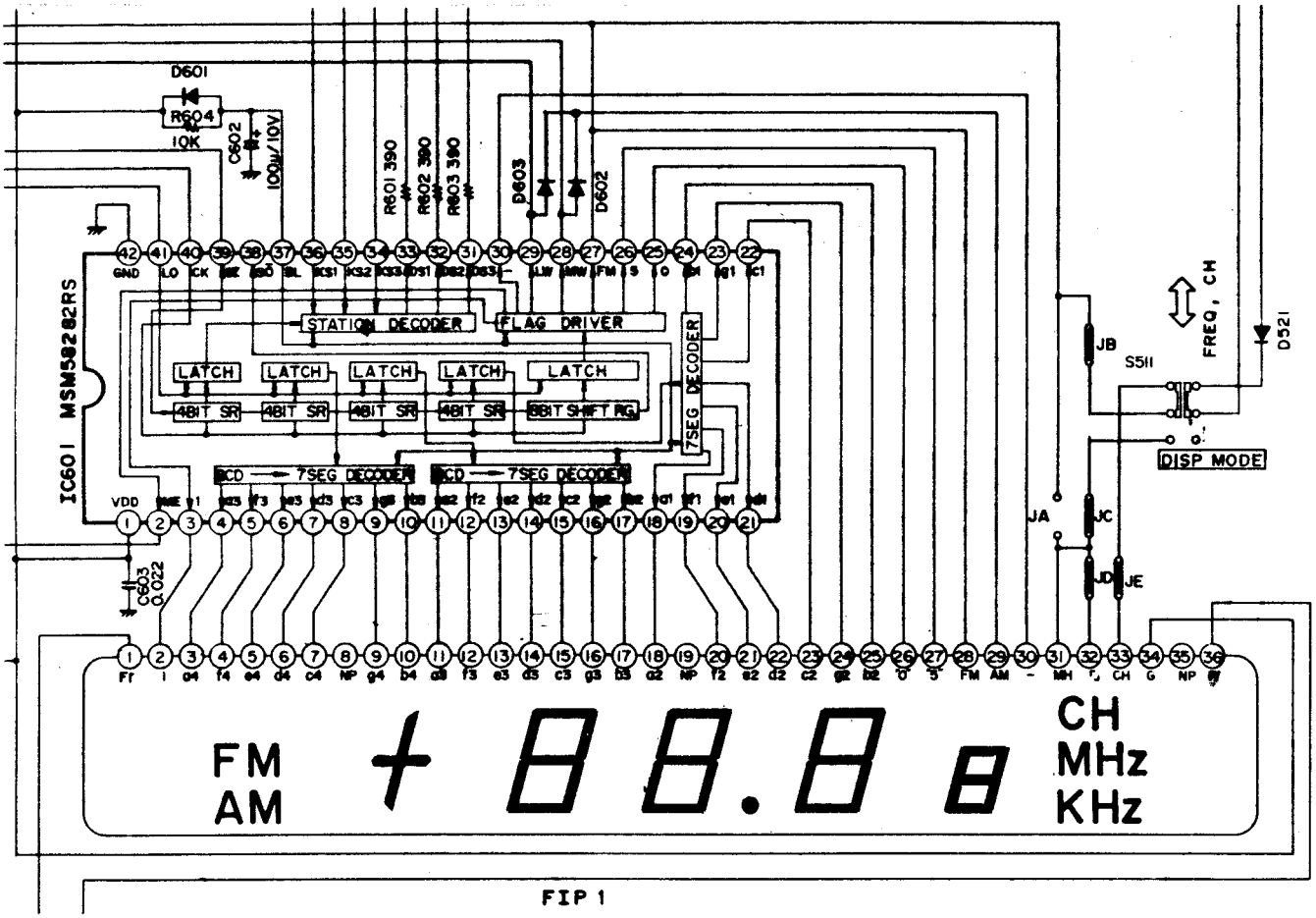


Fig. 57 FL Tube Drive Circuit

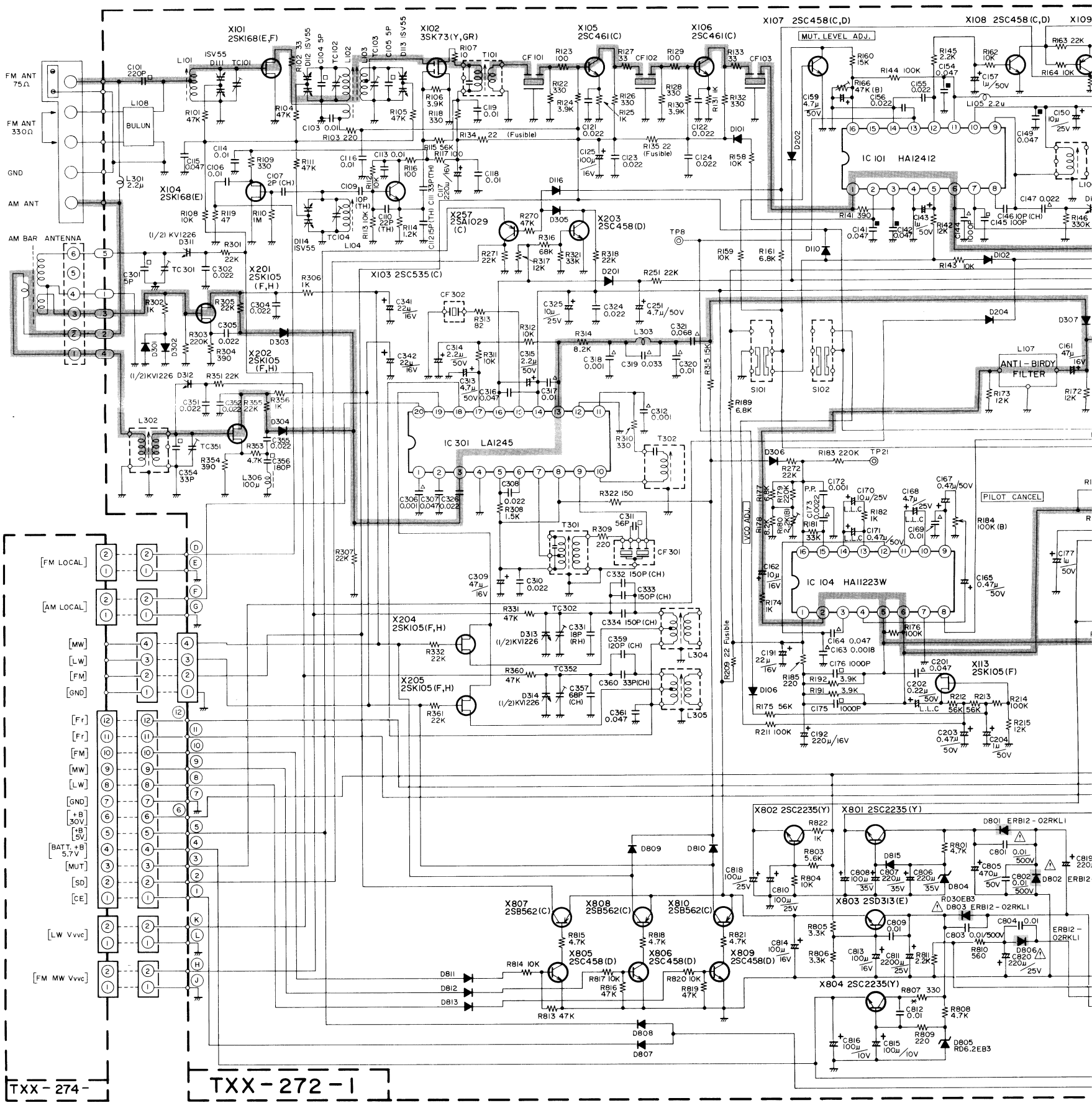
The above circuit is the 42-pin static drive LSI used to activate the display unit. (The voltage terminals of IC601 are shown Table-2 on page 32.)

- **Operation and effect of voltage conversion (X511, X512)**

X511: B open: FM , AM , MHz , kHz , etc. light.
C–E Short-circuited: The segments in OFF light weakly.

X512: B open: No display appears and no sound is produced. The band mode is not switched.
C–E Short-circuited: Same as above.

T-X6L Schematic Diagram

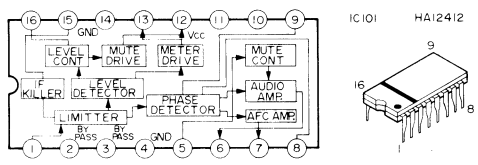


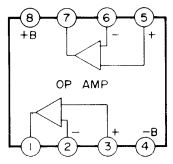
CAUTION

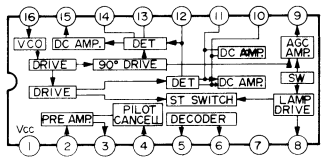
The schematic diagram shown above is for EUROPE.
The primary circuit are different from the diagram for UNITED KINGDOM please use the proper schematic diagram shown on next page.

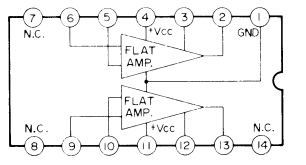
NOTE

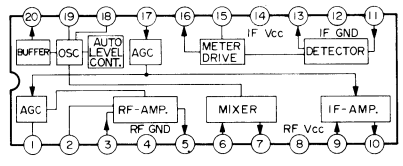
NON MARK			
✳	〃	〃	1/4W CARBON(J)
	〃	〃	1/2W UNFLAMABLE(J)
NON	〃	CAPACITOR	50V CERAMIC(YZ)
□	〃	〃	50V 〃 (SL)(J)
■	〃	〃	25V 〃 (BC)(M)
△	〃	〃	50V MYLAR(K)
⊣⊢	〃	〃	E CAPACITOR (A)
⊛	〃	〃	〃 (LLC)
●	〃	〃	POLYPROYLENE CAPACITOR(J)
○	〃	〃	NON POLAR CAPACITOR

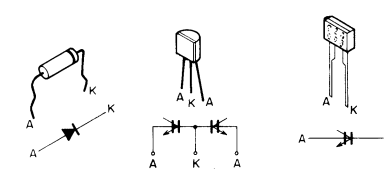










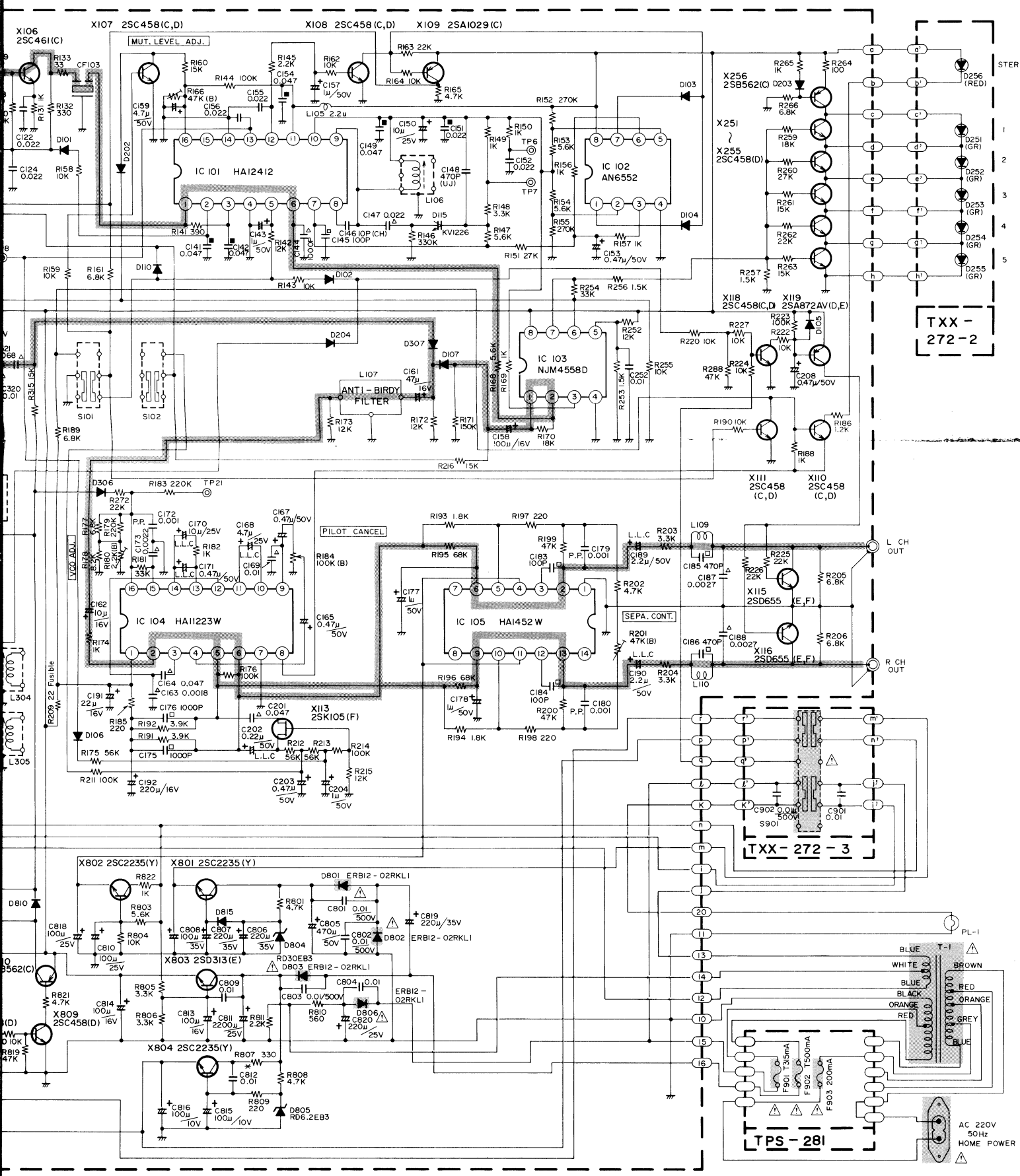


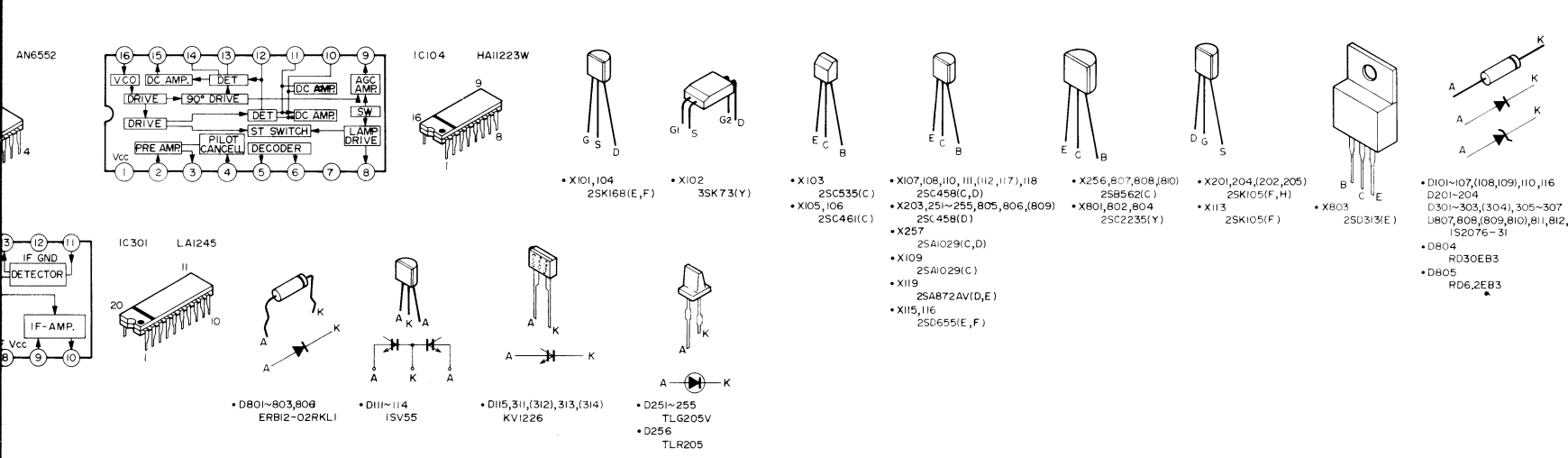
Notes:

1. —— indicates +B power supply.
2. —— indicates -B power supply.
3. ▒▒ indicates signal path.
4. When replacing the parts in the darkened area ▒▒ and those market with ⚠ be sure to use the designated parts to ensure safety.
5. This is the standard circuit diagram.
   The design and contents are subject to change without notice.

Printed Circuit Board Ass'y Locations

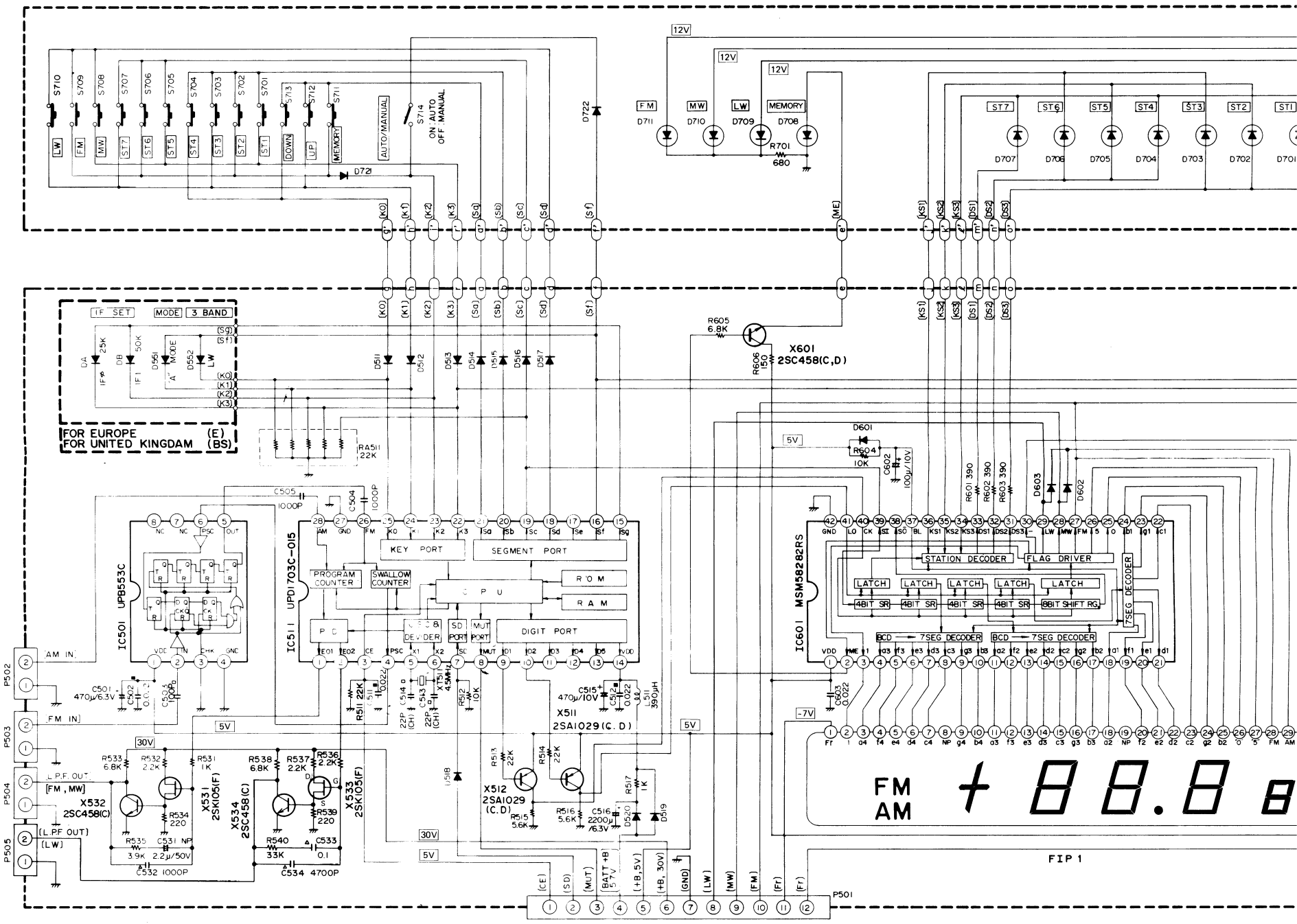
P.C. Board Ass'y	Description
TXX-272	FM/AM Tuner and Power Supply P
TXX-274	PLL Synthesizer and Control P.C. B
TPS-281	Fuse P.C. Board Ass'y





Printed Circuit Board Ass'y Locations

P.C. Board Ass'y	Description	Page
TXX-272	FM/AM Tuner and Power Supply P.C. Board Ass'y	9
TXX-274	PLL Synthesizer and Control P.C. Board Ass'y	14
TPS-281	Fuse P.C. Board Ass'y	16



SLR-54GC
D709-D711

TLR205
D701 ~ D707

TLY205
D708

IS2076-31
D721 ~ D722
D601 ~ D603
D551 ~ D552
DA ~ DB
D511 ~ D521

2SK105(F)
X531, X533

2SA1029(C,D)
X511, X512

2SC458(C,D)
X601

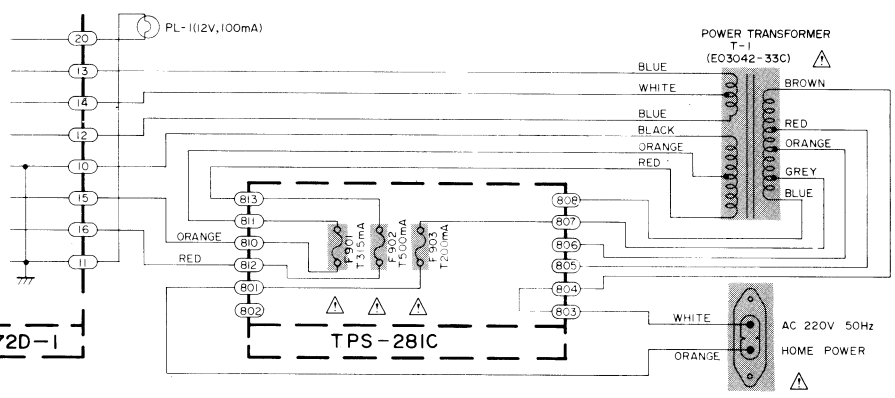
2SC458(C)
X532, X534

IC501
UPB553C

IC511
UPD1703C-015

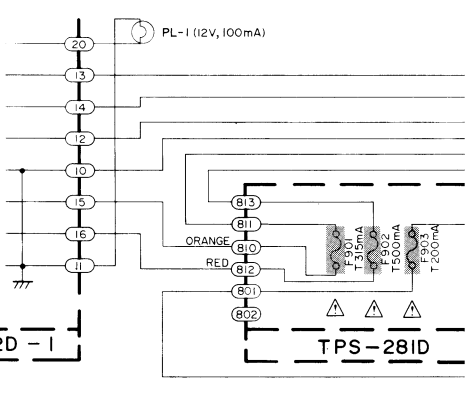
T-X6L (E) FOR EUROPE

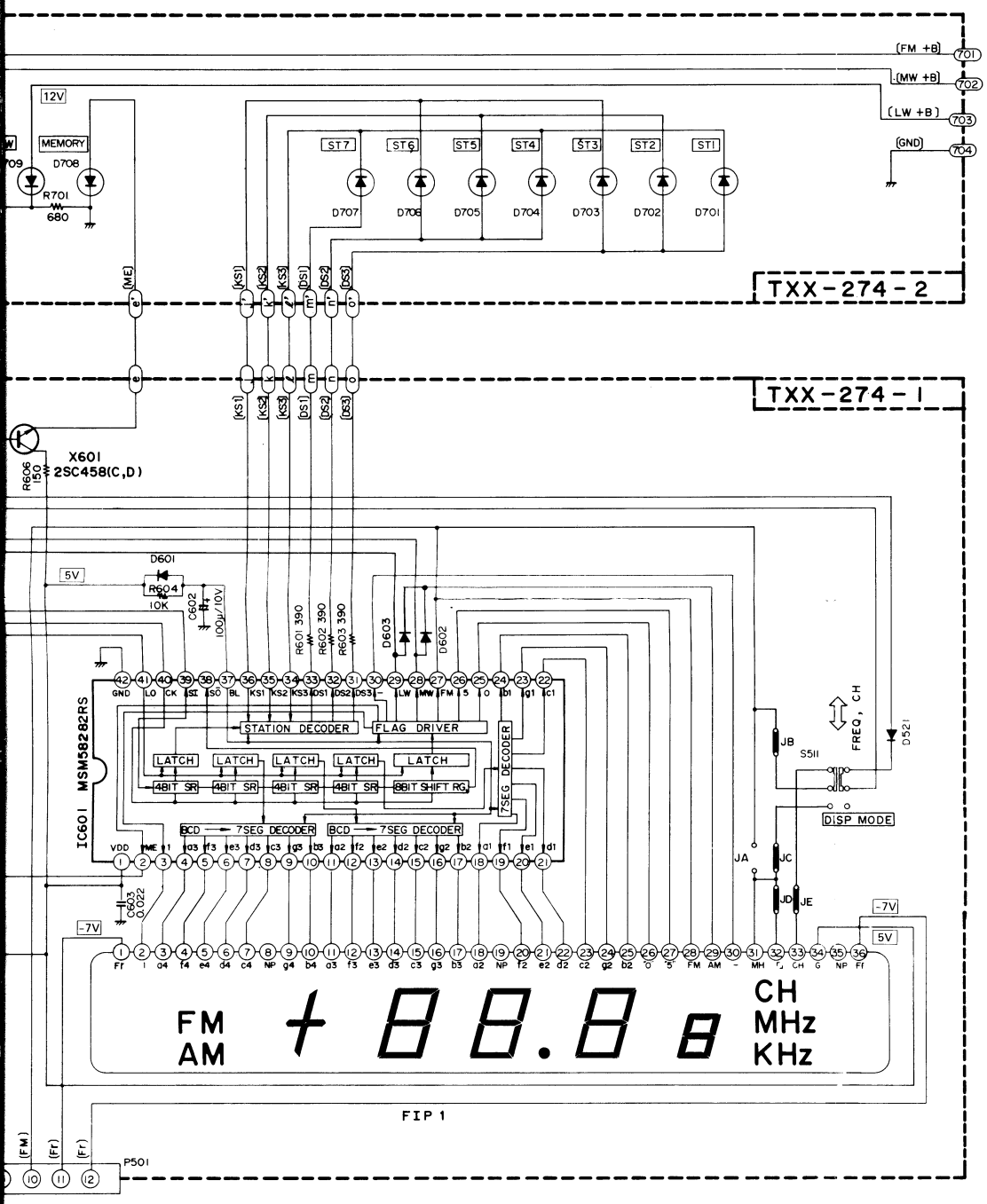
PRIMARY CIRCUIT : AC 220V 50Hz
DE EMPHASIS : 50μ SEC (USE TXX-272D for T-X6)



T-X6L (BS) FOR UNIT

PRIMARY CIRCUIT : AC 240V 50Hz
DE-EMPHASIS : 50μ SEC (USE TXX-2





IC PIN VOLTAGE (V)

PIN NO	IC601 MSM 58282RS	IC511 UPD1703-015	IC501 UPB 553C
1	4.7	0.8	4.9
2	0	0	3.7
3	0.7	5.0	0
4	4.2	0.2	0
5	4.3	0.1	3.4
6	4.2	2.1	0.2
7	4.2	0	0
8	4.2	0	0
9	4.2	4.8	NOTE : STATION SWITCH IS SELECTED ST-1 (FM. 88.00MHz). AUTO OR MANUAL SWITCH IS SELECTED MANUAL. FROE/CH SWITCH IS SELECTED FREQUENCY.
10	4.2	4.8	
11	4.2	4.8	
12	4.2	4.8	
13	4.2	4.8	
14	4.2	5.0	
15	4.2	0	
16	4.2	1.0	
17	4.2	0	
18	4.2	0.8	
19	4.2	0.9	
20	4.2	1.0	
21	4.2	1.0	
22	4.2	0	
23	-0.5	0	
24	4.2	0.9	
25	4.4	0.9	
26	-0.3	0.2	
27	3.6	0	
28	-1.0	3.3	
29	-1.0		
30	-1.0		
31	4.0		
32	0		
33	0		
34	0.3		
35	0.5		
36	0.5		
37	3.2		
38	0		
39	0.9		
40	0		
41	0		
42	0		

USED JAMPER

JA	JB	JC	JD	JE
OFF	ON	ON	ON	ON

IF SET DIODE (DA DB)

DA	DB	IF FREQ,(MHz)	USED C,FILTER
OFF	OFF	10.700	RED
OFF	ON	NON USE	
ON	OFF	10.725	ORG
ON	ON	10.675	BLU

(NOTE)

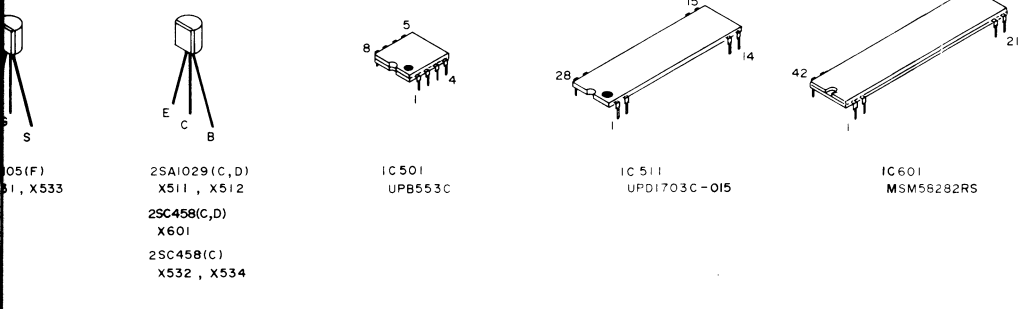
○ RESISTOR
NON MARK 1/4W CARBON (J)

○ CAPACITOR

NON MARK	50V	CERAMIC (YZ)
□	50V	CERAMIC (SL)(J)
■	25V	CERAMIC (BC)(M)
△	50V	MYLAR (K)
+‖—		E.CAPACITOR (A)
NP‖—		NON POLAR E. CAPACITOR

KEY MATRIX

	K3	K2	K1	K0
Sa		MEMORY	UP	DOWN
Sb	ST 1	ST 2	ST 3	ST 4
Sc	ST 5	ST 6	ST 7	
Sd	MW	FM	LW	
Se				
Sf	CH/Freq, (S511)	AUTO/MANUAL (S714)	MODE A/B (D551)	FM BAND 3/2 (D552)
Sg	IF SET IF0 (DA)	IF SET IF1 (DB)		



05(F)
31, X533

2SA1029(C,D)
X511, X512
2SC458(C,D)
X601
2SC458(C)
X532, X534

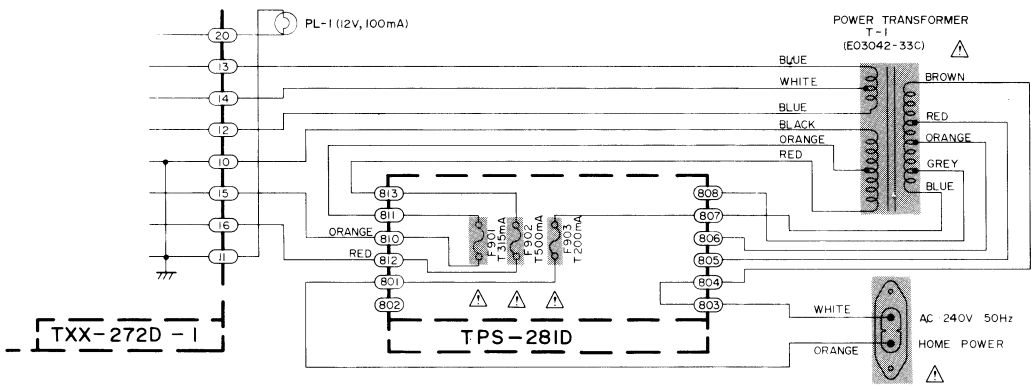
IC501
UPB553C

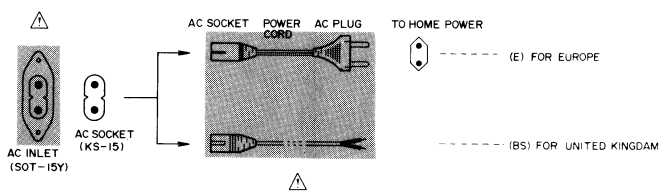
IC511
UPD1703C-015

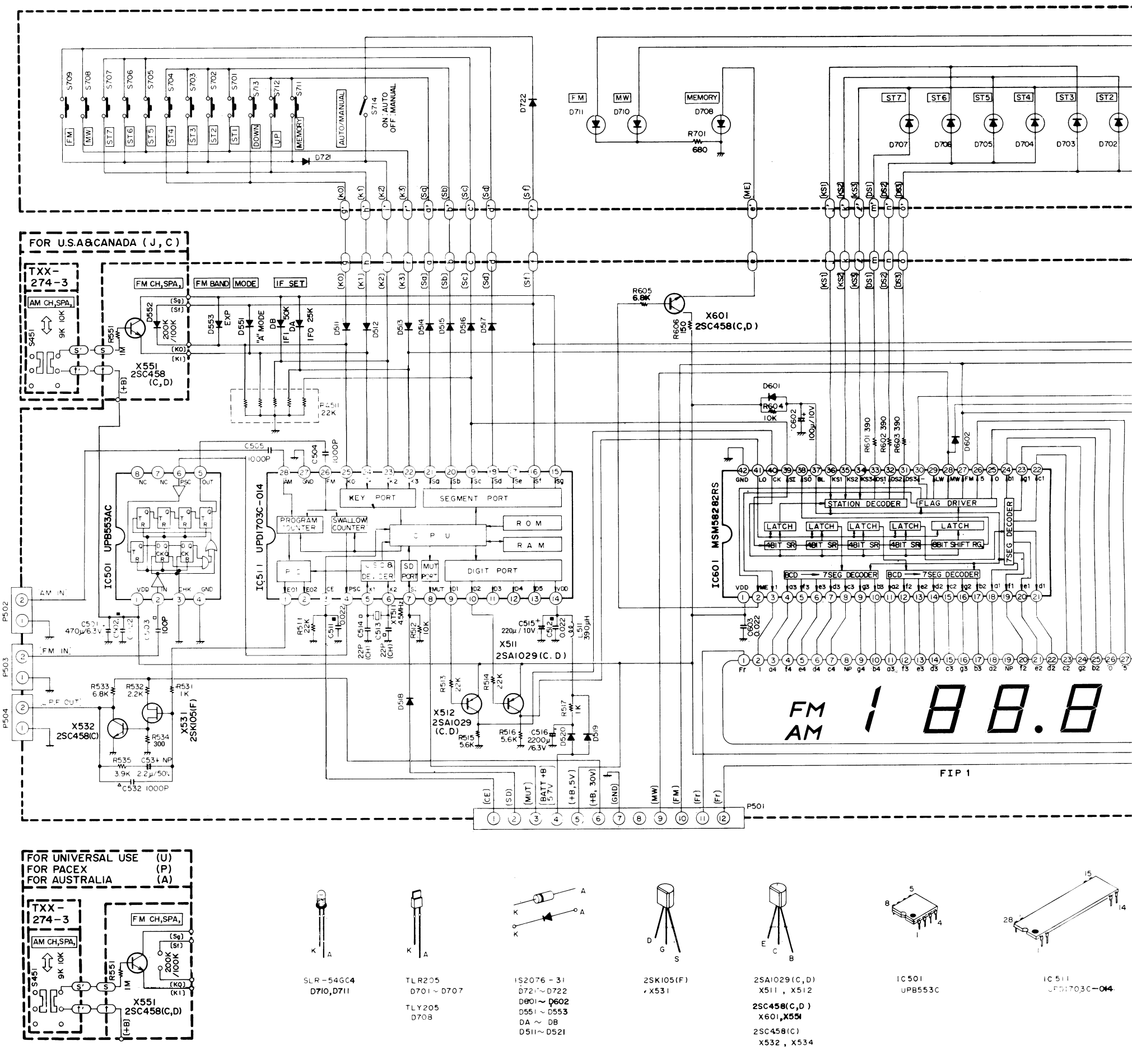
IC601
MSM58282RS

T-X6L (BS) FOR UNITED KINGDOM

PRIMARY CIRCUIT : AC 240V 50Hz
DE-EMPHASIS : 50μ SEC (USE TXX-272DBS)

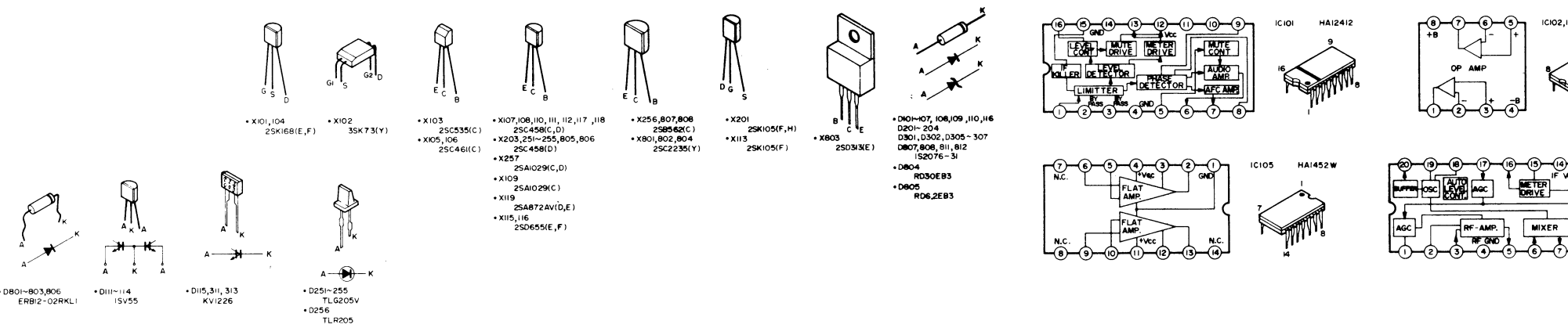


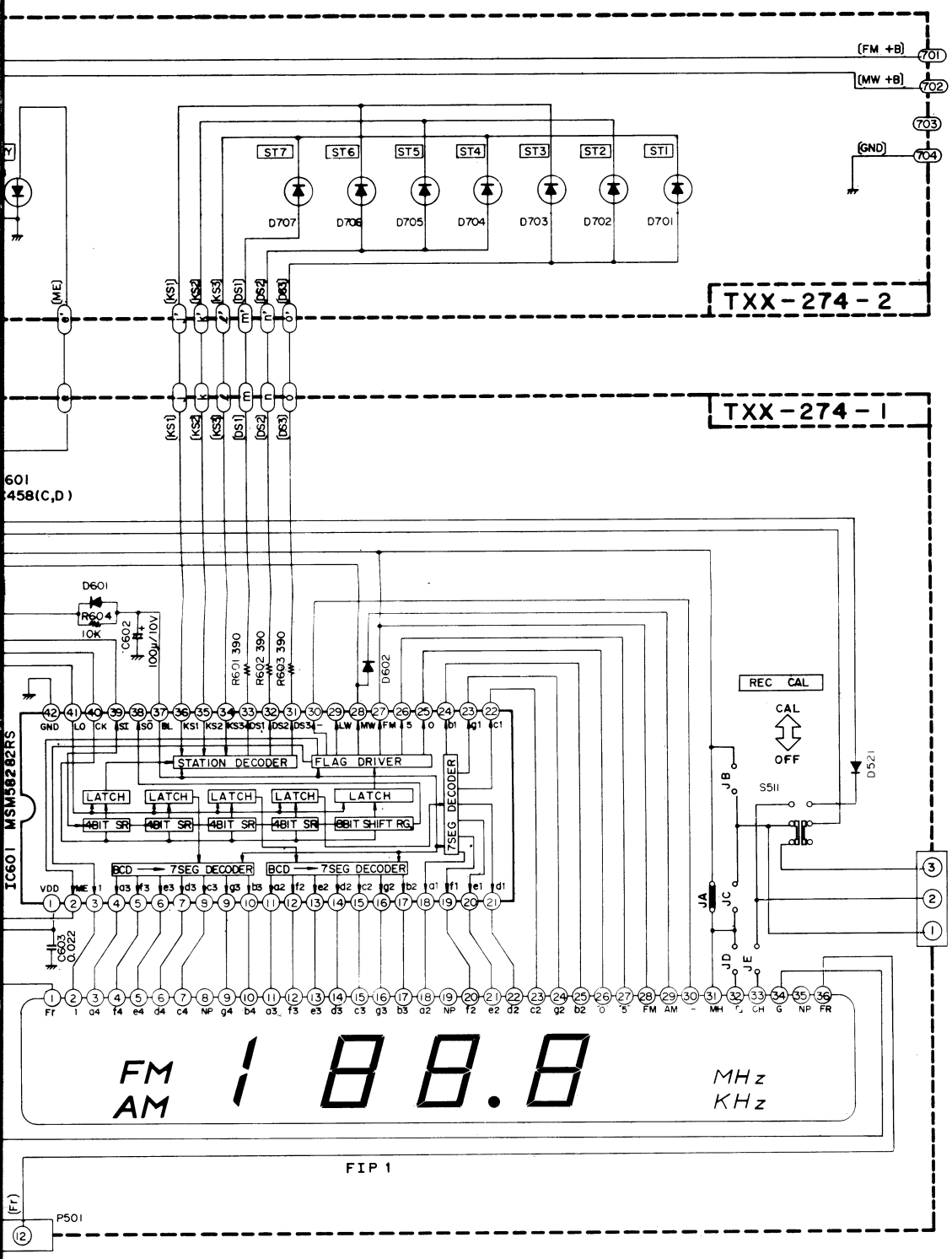



FOR U.S.A&CANADA (J, C)
TXX-274-3
AM CH,SPA,
FM CH,SPA,
FM BAND
MODE
IF SET
S451
9K 10K
R551 1M
D552 200K /100K
D553 EXP
D551 "A" MODE
DB 50K
DA IFI 25K
IFO 25K
D511 D512 D513 D514 D515 D516 D517
X551 2SC458 (C,D)
(+B)
R451 22K
C505 1000P
C504 1000P
IC501 UPB553AC
NC NC PSC OUT
VDD TN CHK GND
IC511 UPD1703C-014
KEY PORT
SEGMENT PORT
PROGRAM COUNTER
SWALLOW COUNTER
C P U
R O M
R A M
P I O
SERIAL BUS DRIVER
SD PORT
MUT PORT
DIGIT PORT
AM IN
FM IN
P502
P503
P504
C501 470µ/6.3V
C502 0.022
C503 100P
R511 22K
C511 0.022
C514 22P (CH)
C513 22P (CH)
X511 4.5MHz
R512 10K
C515 220µ / 10V
C512 0.022
L511 390µH
X511 2SA1029(C. D)
R513 22K
R514 22K
X512 2SA1029 (C.D)
R515 5.6K
R516 5.6K
C516 2200µ /6.3V
R517 1K
D520
D519
D518
R533 6.8K
R532 2.2K
R531 1K
L.P.F OUT
X532 2SC458(C)
R534 300
R535 3.9K
C531 NP
2.2µ/50V
C532 1000P
X531 2SK105(F)
D722
FM D711
MW D710
MEMORY D708
R701 680
D707 D706 D705 D704 D703 D702
R605 6.8K
R606 150
X601 2SC458(C,D)
D601
R604 10K
C602 100µ/10V
R601 390
R602 390
R603 390
D602
IC601 MSM58282RS
STATION DECODER
FLAG DRIVER
LATCH
4BIT SR
8BIT SHIFT RG.
7SEG DECODER
BCD → 7SEG DECODER
C603 0.022
FM
AM
FIP 1
P501
(CE) (SD) (MUT) (BATT +B 5.7V) (+B, 5V) (+B, 30V) (GND) (MW) (FM) (Fr) (Fr)

FOR UNIVERSAL USE (U)
FOR PACEX (P)
FOR AUSTRALIA (A)
TXX-274-3
AM CH,SPA,
FM CH,SPA,
S451
9K 10K
R551 1M
X551 2SC458(C,D)
(+B)

SLR-54GC4
D710, D711
TLR205
D701 ~ D707
TLY205
D708
IS2076-31
D721~D722
D801~D802
D551 ~ D553
DA ~ DB
D511~D521
2SK105(F)
X531
2SA1029(C,D)
X511 , X512
2SC458(C,D)
X601, X551
2SC458(C)
X532 , X534
IC501
UPB553C
IC511
UPD1703C-014


• X101, 104 2SK168(E, F)
• X102 3SK73(Y)
• X103 2SC535(C)
• X105, 106 2SC461(C)
• X107, 108, 110, 111, 112, 117, 118 2SC458(C, D)
• X203, 251~255, 805, 806 2SC458(D)
• X257 2SA1029(C, D)
• X109 2SA1029(C)
• X119 2SA872AV(D, E)
• X115, 116 2SD655(E, F)
• X256, 807, 808 2SB562(C)
• X801, 802, 804 2SC2235(Y)
• X201 2SK105(F, H)
• X113 2SK105(F)
• X803 2SD313(E)
• D101~107, 108, 109, 110, 116
D201~ 204
D301, D302, D305 ~ 307
D807, 808, 811, 812
IS2076-31
• D804 RD30EB3
• D805 RD6.2EB3
IC101 HA12412
IC102, 103
IC105 HA1452W
• D801~803, 806 ERB12-02RKL1
• D111~114 1SV55
• D115, 311, 313 KV1226
• D251~255 TLG205V
• D256 TLR205


(FM +B) 701
(MW +B) 702
703
(GND) 704
ST7 ST6 ST5 ST4 ST3 ST2 ST1
D707 D706 D705 D704 D703 D702 D701
TXX-274-2
TXX-274-1
(ME)
(KS1) (KS2) (KS3) (DS1) (DS2) (DS3)
IC601
2SC458(C,D)
D601
RS04
10K
C602
100μ/10V
R601 390
R602 390
R603 390
D602
REC CAL
CAL
OFF
D521
S511
JA JB JC JD JE
42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22
GND LO CK ST SO BL KS1 KS2 KS3 DS1 DS2 DS3 – ALW MW FM 5 10 db1 fg1 fc1
STATION DECODER
FLAG DRIVER
LATCH LATCH LATCH LATCH LATCH
4BIT SR 4BIT SR 4BIT SR 4BIT SR 8BIT SHIFT RG
7SEG DECODER
BCD → 7SEG DECODER
BCD → 7SEG DECODER
IC601 MSM58282RS
VDD TME fg1 fg3 fe3 fd3 fc3 fg3 fb3 fa2 ff2 fe2 fd2 fc2 fg2 fb2 fa1 ff1 fe1 fd1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
C603 0.022
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Fr 1 a4 f4 e4 d4 c4 NP g4 b4 a3 f3 e3 d3 c3 g3 b3 a2 f2 e2 d2 c2 g2 b2 a1 f1 e1 d1 CH G NP FR
FM
AM
188.8
MHz
KHz
FIP 1
(Fr)
12
P501

IC PIN VOLTAGE (V)

PIN NO	IC601 MSM 58282RS	IC511 UPD 1703-014	IC501 UPB 553C
1	4.9	0.8	4.9
2	0	0	3.7
3	1.3	5.0	0
4	4.2	0.2	0
5	4.2	0.1	3.4
6	4.2	2.1	0.2
7	4.2	0	0
8	4.2	0	0
9	4.2	4.8	
10	4.2	4.8	
11	4.2	4.8	
12	4.2	4.8	
13	4.2	4.8	
14	4.2	5.0	
15	4.2	0	
16	4.2	1.0	
17	4.2	0	
18	4.2	0.8	
19	4.2	0.9	
20	4.2	1.0	
21	4.2	1.0	
22	4.2	0	
23	-0.5	0	
24	4.2	0.9	
25	-0.7	0.9	
26	-0.3	0.2	
27	3.6	0	
28	-2.6	3.3	
29	-2.6		
30	-1.0		
31	4.0		
32	0		
33	0		
34	0.3		
35	0.5		
36	0.5		
37	3.2		
38	0		
39	0.9		
40	0		
41	0		
42	0		

NOTE : STATION SWITCH IS SELECTED ST-1 (FM. 88.00MHz)
AUTO OR MANUAL SWITCH IS SELECTED MANUAL.
REC LEVEL SWITCH IS SELECTED OFF.

USED JAMPER

JA	JB	JC	JD	JE
ON	OFF	OFF	OFF	OFF

IF SET DIODE (DA DB)

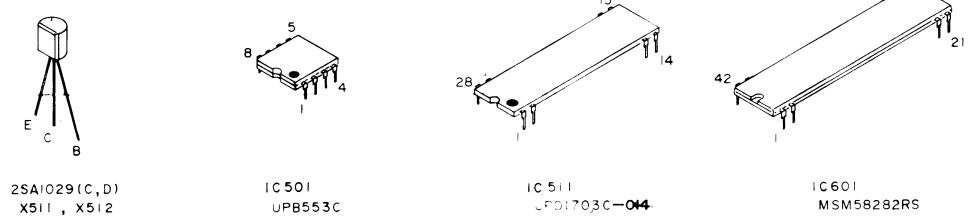
DA	DB	IF FREQ,(MHz)	USED C,FILTER
OFF	OFF	10.700	RED
OFF	ON	NON USE	
ON	OFF	10.725	ORG
ON	ON	10.675	BLU

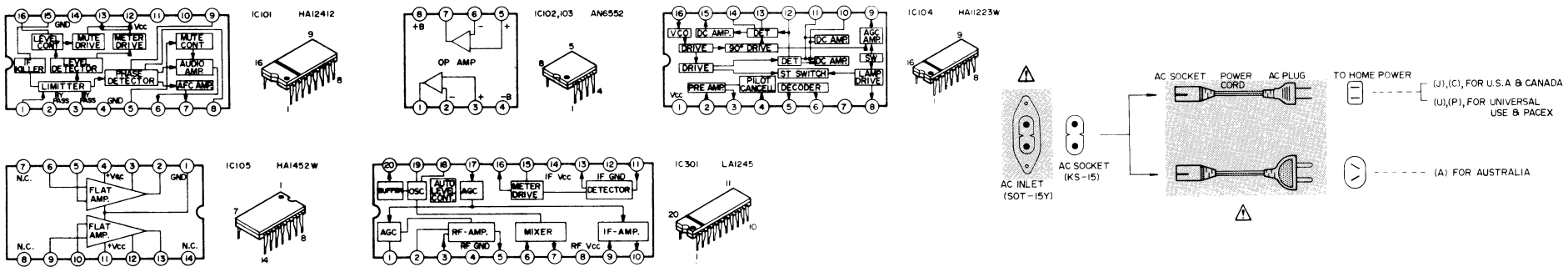
(NOTE)

- RESISTOR
  NON MARK 1/4W CARBON (J)
- CAPACITOR
  NON MARK 50V CERAMIC (YZ)
  □ 50V CERAMIC (SL)(J)
  ■ 25V CERAMIC (BC)(M)
  △ 50V MYLAR (K)
  E.CAPACITOR (A)
  NP NON POLAR E.CAPACITOR

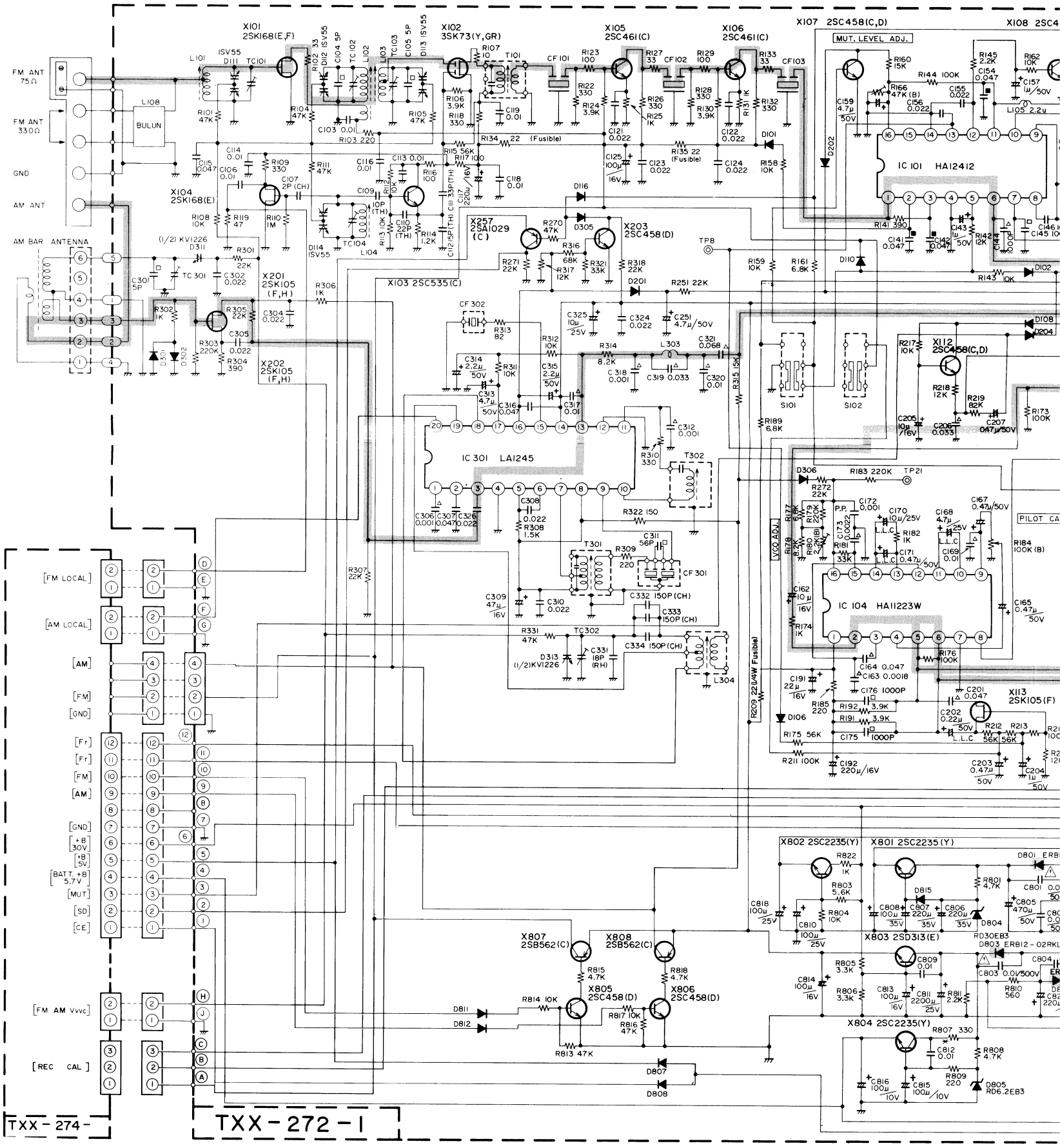
KEY MATRIX

	K3	K2	K1	K0
Sa		MEMORY	UP	DOWN
Sb	ST 1	ST 2	ST 3	ST 4
Sc	ST 5	ST 6	ST 7	
Sd	AM	FM		
Se				
Sf	REC LEVEL ON/OFF(S511)	AUTO/MANUAL (S714)	MODE A/B (D551)	FM CH, SPA, 100K/200K (D552)
Sg	IF SET IFO (DA)	IF SET IF1 (DB)	AM CH,SPA, 10K/9K (S451)	FM BAND EXP/JAP(D553)





T-X6 Schematic Diagram



CAUTION

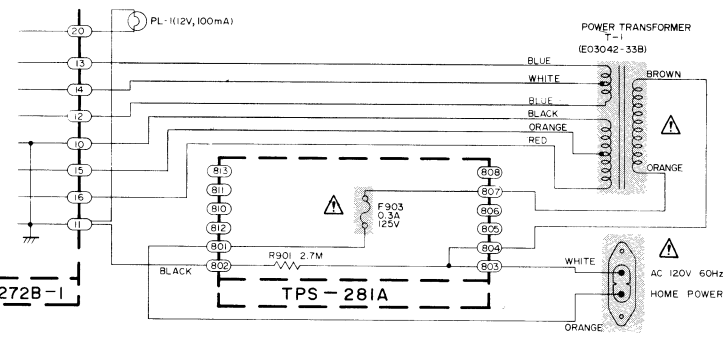
The schematic diagram shown above is for U.S.A. and Canada.
The primary circuit are different from the diagram for Othre Countries therefore please use the proper schematic diagram shown on next page.

NOTE

NON MARK		RESISTOR	1/4W	CARBON(J)
✱	"	"	1/2W	UNFLAMABLE(J)
NON	"	CAPACITOR	50V	CERAMIC(YZ)
□	"	"	50V	" (SL)(J)
■	"	"	25V	" (BC)(M)
△	"	"	50V	MYLAR(K)
⊣⊢	"	"		E CAPACITOR (A)
⊛	"	"		" (LLC)
●	"	"		POLYPROYLENE CAPACITOR(J)
○	"	"		NON POLAR CAPACITOR

T-X6 (J) FOR U.S.A & (C) FOR CANADA

PRIMARY CIRCUIT : AC 120V 60Hz
DE-EMPHASIS : 75μ SEC (USE TXX-272B)

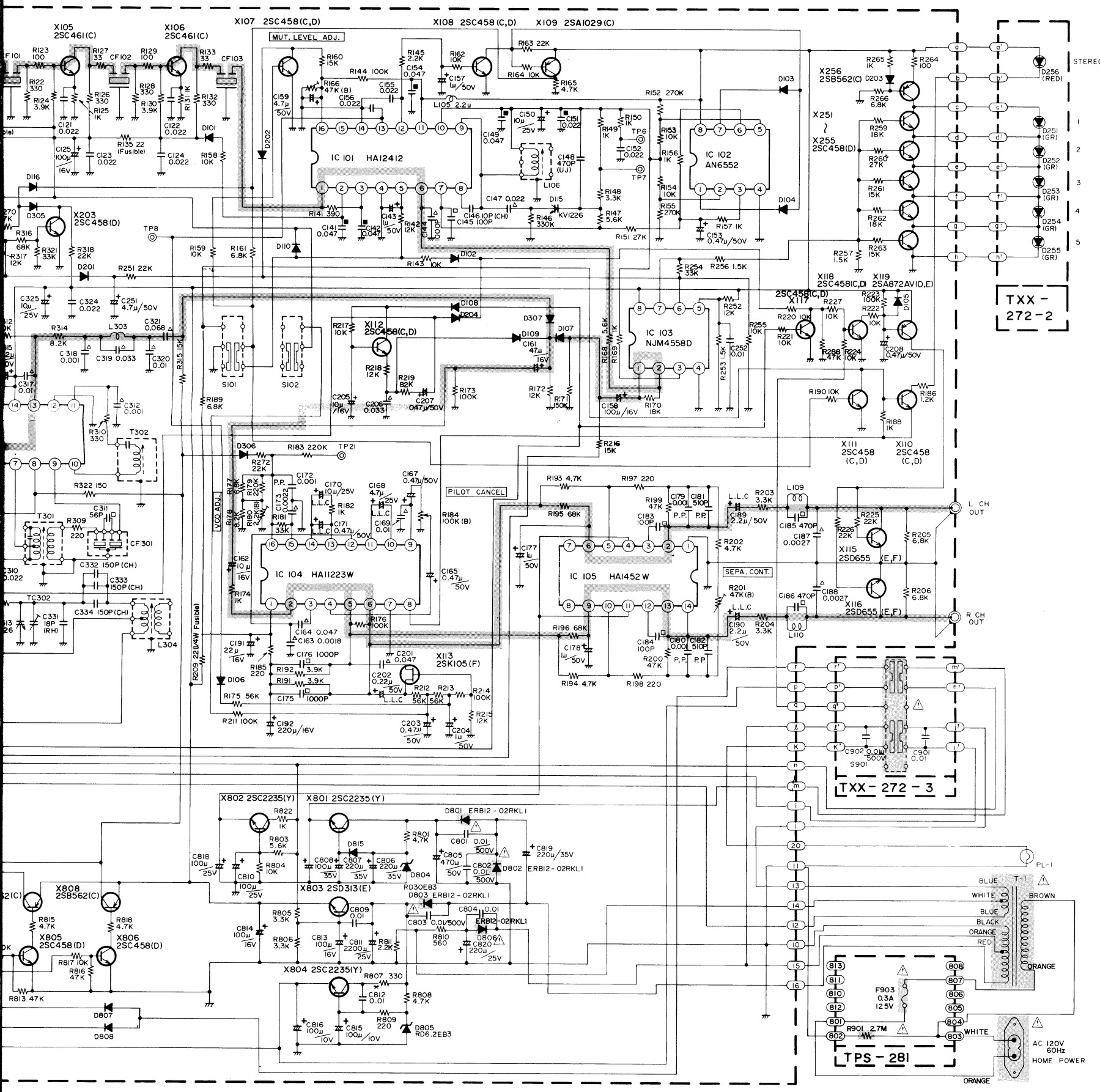


Notes:

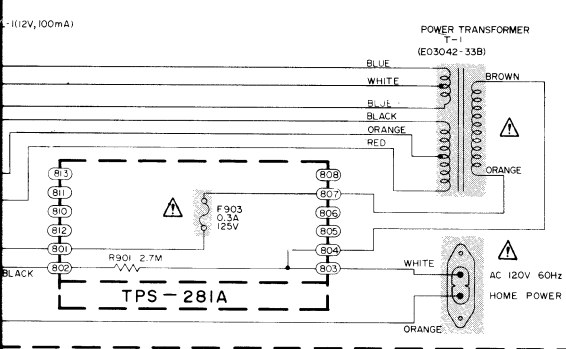
1. —— indicates +B power supply.
2. —— indicates -B power supply.
3. ▒▒ indicates signal path.
4. When replacing the parts in the darkened area ▒▒ and those market with ⚠ be sure to use the designated parts to ensure safety.
5. This is the standard circuit diagram.
   The design and contents are subject to change without notice.

Printed Circuit Board Ass'y Locations

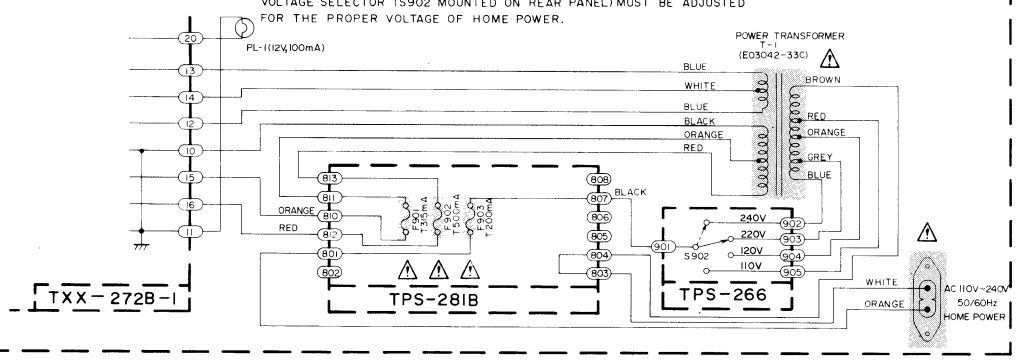
P.C. Board Ass'y	Description
TXX-272	FM/AM Tuner and Power
TXX-274	PLL Synthesizer and Cont
TPS-281	Fuse P.C. Board Ass'y
TPS-266	Voltage Selector P.C. Boar (except U.S.A. & Canada)



FOR U.S.A & (C) FOR CANADA



T-X6 (U) FOR UNIVERSAL USE, (P) FOR PACEX & (A) FOR AUSTRALIA



Printed Circuit Board Ass'y Locations

P.C. Board Ass'y	Description	Page
TXX-272	FM/AM Tuner and Power Supply P.C. Board Ass'y	10
TXX-274	PLL Synthesizer and Control P.C. Board Ass'y	15
TPS-281	Fuse P.C. Board Ass'y	17
TPS-266	Voltage Selector P.C. Board Ass'y (except U.S.A. & Canada)	17